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DEVOTED ESPECIALLY TO THE STUDY OF FUNGI

IN THEIR RELATION TO PLANT DISEASES.

EDITED BY

THE CHIEF OF DIVISION AND HIS ASSISTANTS.

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EXPERIMENTS IN THE TREATMENT OF PLANT DISEASES.

By B. T. GALLOWAY and D. G. FAIRCHILD.

PART I.

TREATMENT OF BLACK ROT OF GRAPES.

The present season a series of experiments was made by the writers with a view of determining the value of certain lines of treatment for several destructive plant diseases. The results of this work we propose to set forth in two or three papers which we hope to get into the hands of fruit growers, and others directly interested, before spring. The present paper relates to an experiment made in the treatment of black rot of the grape, at Vienna, Va., 12 miles southwest of Washington.

The vineyard is the property of Capt. J. O. Berry and consists of 1,000 Concord vines sixteen years old trained to stakes 8 feet high. The vines had never been treated for rot, in fact they had been practically abandoned for the past five years on account of this disease. This, together with the fact that there had been little done in the way of pruning or soil cultivation, offered the very best means of thoroughly testing the value of the fungicides.

In the experiments an endeavor was made to throw some light on the following questions:

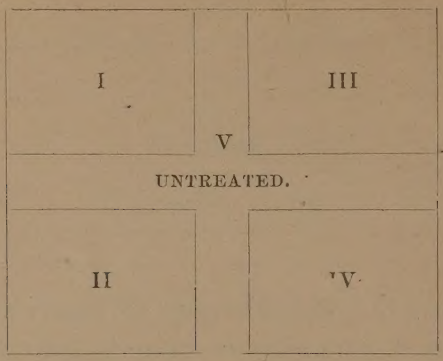
I. The best means of applying the preparations.

II. The relative value of the Bordeaux mixture, ammoniacal copper carbonate solution, copper carbonate in suspension, and a mixed treatment consisting of three applications of the Bordeaux mixture followed by five of the ammoniacal solution.

III. The actual cost of each treatment.

IV. The amount of copper found at the harvest on fruit treated with Bordeaux mixture.

The vineyard was divided into five plats as shown in the accompanying diagram.



Plat I, consisting of 203 vines, was treated with Bordeaux mixture, formula *b*.

Plat II, of 221 vines, treated with ammoniacal solution of copper carbonate.

Plat III, 167 vines, treated with copper carbonate in suspension, 3 ounces to 22 gallons of water.

Plat IV, 183 vines, treated three times with Bordeaux mixture, followed by five applications of the ammoniacal copper carbonate solution.

Plat V, 179 vines, no treatment.

All of the plats received eight sprayings, the first on May 1, and the rest, excepting the last, at intervals of fifteen days. The last spraying, on account of dry weather, was prolonged to 20 days.

Plats I to IV, inclusive, were of practically the same area, but owing to removals of dead vines an actual count revealed the number for each division to be as given above.

Of the various plats it may be said that early in the work it was observed that Plat I was made up of superior, and Plat III of inferior vines. Hence it was not expected that there would be entire uniformity in the yield of the various divisions even if the treatment for all had been the same. The pruning for 1890 was done in March, and at the same time the weeds, grass, and old berries were plowed under. This work was rather hastily done, as could be seen from the quantities of débris lying about under the vines even as late as the middle of April.

Applying the Remedies.—In this work three spraying machines were tried, namely, the Eureka, manufactured by Adam Weaber, of Vineland, N. J.; the Japy, made for us by the Columbia Brass Works, of Washington, D. C., and a Little Giant machine manufactured by the

Nixon Nozzle and Machine Company, of Dayton, Ohio. The Eureka and Japy are knapsack pumps, each holding about 4 gallons. The Little Giant is a cart machine holding 40 gallons and is designed to be drawn by hand. After a careful test of all the machines the Little Giant was selected as the one best adapted to our wants. It was provided with 16 feet of hose, and owing to the manner in which the vines were trained this enabled us to treat 4 rows at a time. There is no doubt that the knapsack pumps are less wasteful than the Nixon machine, and when arrangements can be made for properly filling them without loss of time they will doubtless be found as effectual and economical for reasonably small vineyards as any pumps now in use. Of course, for large vineyards one should have a machine capable of utilizing horse power. Throughout the experiments we used the Improved Vermorel nozzle and lance, which has already been figured and described in the published reports of this Division.*

Relative value of the treatments.—During the entire work an endeavor was made to have the conditions for all the plats as nearly alike as possible, in order that at the harvest the percentage showing the relative value of the treatments might be obtained. For reasons already given the total yields for the various plats were not to be relied upon, hence the following plan was adopted for determining the effects of the sprayings.

On July 30, when it was evident that no further changes due to the disease would occur in the fruit, the different plats were carefully examined and every bunch counted. As the counting proceeded the bunches were divided into two classes, namely, diseased and healthy. Every bunch showing five or more diseased berries was classed as diseased, while all bunches having less than five diseased berries were counted healthy. Assuming that all of the diseased bunches were *lost*, we were able by a single calculation to get the percentage of fruit saved for each plat. A comparison of these percentages shows the value of the various treatments. The only source of error in such a calculation is that some of the treated bunches might have become diseased and dropped from the vines before the count was made. This would have been serious had it not been carefully noted, at frequent intervals during the entire work, that the treated sections scarcely lost a berry.

Below are given the results of the count as above described:

PLAT I.

Treated with Bordeaux mixture.

Number of vines	203
Total number of bunches	2,289
Number of diseased bunches	19
Number of healthy bunches	2,270
Per cent. saved	99.2

* Journal of Mycology, vol. 6, No. ii, p. 57. Circular No. 8.

PLAT II.

Treated with the ammoniacal copper carbonate solution.

Number of vines	221
Total number of bunches	3,135
Number of diseased bunches	80
Number of healthy bunches	3,055
Per cent. saved	97.5

PLAT III.

Treated with copper carbonate in suspension.

Number of vines	167
Total number of bunches	708
Number of diseased bunches	45
Number of healthy bunches	663
Per cent. saved	93.64

PLAT IV.

Treated three times with the Bordeaux mixture, followed by five applications of the ammoniacal copper carbonate solution.

Number of vines	186
Total number of bunches	1,866
Number of diseased bunches	51
Number of healthy bunches	1,815
Per cent. saved	97.27

PLAT V.

No treatment.

In this plat, consisting of 179 vines, every bunch was diseased, so that according to the classification adopted the loss was total. By the 21st of July the majority of the bunches had fallen. On the 30th, however, it was thought best to count all bunches which had two or more healthy berries upon them. As a result of this count it was found that the yield was 170 bunches, none of which were fit for market.

Bringing together now the several percentages of fruit saved we have for—

Bordeaux mixture	99.20
Ammoniacal copper carbonate solution	97.50
Copper carbonate in suspension	93.64
Bordeaux mixture and ammoniacal copper carbonate solution	97.27
Untreated	00.00

Cost of the various treatments.—The total cost of treating each plat, estimating the labor at 15 cents an hour, was as follows:

PLAT I.—203 *vines.*

Bordeaux mixture.

210 gallons of mixture	$4.41
14 hours labor	2.10
Total	6.51
	Cents.
Cost per vine	3.2
Cost per pound of fruit	1.2

PLAT II.—221 *vines.*

Ammoniacal copper carbonate solution.

196 gallons of solution	$1.47
12½ hours labor	1.85
Total	3.32
	Cents.
Cost per vine	1.50
Cost per pound of fruit	.77

PLAT III.—167 *vines.*

Copper carbonate in suspension.

147 gallons of solution	$0.75
10 hours labor	1.50
Total	2.25
	Cents.
Cost per vine	1.35
Cost per pound of fruit	2.08

PLAT IV.—186 *vines.*

Bordeaux mixture and ammoniacal solution.

302 gallons of mixture and solution	$3.84
10 hours labor	1.50
Total	5.34
	Cents.
Cost per vine	2.87
Cost per pound of fruit	1.64

The total yield in pounds of the various plats was approximately as follows:

	Pounds.
Plat I	540
Plat II	432
Plat III	108
Plat IV	324
Total	1,404

The fruit was sold on the vines for 6 cents per pound, making the revenue from each plat as follows:

Plat I	$32.40
Plat II	25.92
Plat III	6.48
Plat IV	19.44
Total	84.24

It will be seen by comparing these figures with those giving the total cost of the various treatments, that for Plat I, treated with Bordeaux mixture there was saved $32.40 worth of fruit at an expenditure of $6.51, leaving a profit of $25.89, or 397 per cent.

For Plat II, treated with ammoniacal copper carbonate solution, there was saved $25.92 worth of fruit at a cost of $4.32, leaving a profit of $21.60, or 500 per cent.

For Plat III, treated with copper carbonate in suspension, the value of the fruit saved was $6.48, the cost of treatment $2.25, leaving a profit of $4.23, or 188 per cent.

For Plat IV, treated with Bordeaux mixture and ammoniacal solution, the value of the fruit saved was $19.44, the expense of treatment $3.34, leaving a profit of $16.10, or 482 per cent. A further study of these figures, together with those already given, brings out a number of interesting points, chief of which may be mentioned the following:

I. That while the amount of fruit saved by the Bordeaux mixture was greater than that by the ammoniacal solution the latter preparation is, after all, the cheapest. In other words, there was more profit in using the ammoniacal solution than the Bordeaux mixture.

II. A mixed treatment consisting of Bordeaux mixture and ammoniacal solution is more profitable than a treatment of Bordeaux mixture alone, but not as profitable as the ammoniacal solution alone.

III. There is nothing whatever to be gained by treating with the copper carbonate in suspension when the ammonical solution is at hand.

COPPER ON THE FRUIT AT THE TIME OF HARVEST.

The question has often been asked whether there is any danger to be apprehended from eating grapes which have been sprayed with the Bordeaux mixture and other copper solutions.

To obtain some information in regard to this matter representative bunches were taken from Plat I, which was sprayed eight times with Bordeaux mixture.

The last spraying was made on these vines July 30, and between that date and August 28, the day of harvest, only a few slight rains had fallen. The fruit showed the mixture plainly, more pronouncedly in fact than any treated grapes seen in the market. One kilogram of the clusters ($2\frac{1}{3}$ pounds), including the stems, which appeared to have the greater part of the copper, was weighed out, dried, and analyzed.* As a result of this analysis 1 kilogram of the fruit yielded .005 grammes (.077 grain) of metallic copper. On this basis every pound of grapes treated with Bordeaux mixture contained $\frac{35}{1000}$ of a grain of copper. An adult can take from 8 to 12 grains of this salt without fear of serious results, and to get this amount from sprayed grapes he would have to eat from a ton to a ton and a half of fruit.

According to M. Fallot† the minimum amount of copper introduced into the human system daily through the food is 1 milligram, a trifle less

* The charring of the clusters was performed at the Department, but the analysis was kindly made by Dr. R. C. Kedzie, Mich. Ag. College.

† Progrés Agricole et Viticole, June 16, 1890. Bull. 11, Sect. Veg. Pathology, p. 100.

than one-half of that necessarily taken with each pound of grapes, stems and all, sprayed as profusely as those analyzed.

When it is considered that 203 vines received in one season's treatment only 57.25 pounds of copper, or 4½ ounces per vine, the very inconsiderable amount which remains adherent to the berries is not to be wondered at. Although spraying after the middle of July with the Bordeaux mixture is to be avoided, it will be seen that there is no real danger arising therefrom, and when the ammoniacal solution is substituted for the last three sprayings, since it contains only $\frac{1}{32}$ as much copper, there can be no possible danger.

DISEASES OF THE GRAPE IN WESTERN NEW YORK.

Numerous complaints having been received from correspondents in various parts of western New York of a disease which was seriously injuring grape vines, it was decided to send some one into the field to investigate the matter. Accordingly, on October 18, Mr. D. G. Fairchild was directed to visit Lockport, N. Y., and such other points within the State as might be necessary, and to obtain such information and make such investigations as would enable him, if possible, to determine the cause of the trouble and suggest a remedy therefor. Below is Mr. Fairchild's report.

B. T. GALLOWAY,
Chief of Division.

WASHINGTON, D. C., *October* 25, 1890.

SIR: In accordance with your instructions, I left Washington on October 18, proceeding directly to Lockport, N. Y., where, through the kindness of the Niagara White Grape Company, I was enabled to obtain much valuable information relative to the new disease of the grape, which is generally referred to under the name of "blight" or "rust." After leaving Lockport several important grape-growing regions were visited, in all of which the new trouble was found more or less abundantly. I submit my report on the investigations made, and also add some notes on other vine diseases which came under my observation.

Respectfully,

D. G. FAIRCHILD,
Assistant.

REPORT.

The attacks of the disease seem to be confined to bearing vines three or more years from planting. So far as known, it has occurred, during the past season, only in the grape-growing districts of western New York, and is now present in Niagara, Wayne, Cayuga, Seneca, Steuben, and Ontario Counties. While it may be presumed that the same trouble exists in the intervening counties, and, perhaps, in other sections along the Great Lakes, it has not been definitely reported from these localities. This year the disease appeared simultaneously in the different districts soon after September 1, and in most of them for the first time, but in one locality, Ontario, Wayne County, it is reported to have appeared for the first time two years ago, when it did considerable damage. One vineyard was observed which was previously affected, and in this the area diseased this year did not appear to be entirely coincident with the portion worst affected two years ago.

CHARACTERS OF THE DISEASE.

Small irregular blotches of a dark color appear between the veins, these enlarge rapidly, darken to a dull purplish or reddish brown and coalesce so as to fill up the space between the veins which remain green or yellow. These changes occur so rapidly that the foliage seems to change color suddenly. The contrast between the green or light yellow veins and dark purplish brown of the intervening tissues gives a peculiar streaked appearance to the leaves. In the most serious cases they curl up, become dry and brittle, and finally drop from the vine, leaving it nearly bare.

The berries borne upon diseased vines, almost without exception, have a flat, insipid, and often intensely sour taste, due to the fact that they are only partially ripened. When the attack is severe the berries drop off, and the ground beneath a diseased vine is often seen to be covered with half ripe grapes. The berry is found to part from its pedicel taking with it the fibers which enter the interior of the pulp and are normally withdrawn from it when the berry is pulled off. After the crop has been harvested, also, the bunches are found to "shell" badly, ruining them for market.

The roots of diseased vines, when carefully examined, fail to show a healthy growth of young feeding rootlets. When the roots of healthy and unhealthy vines are compared, although as is to be expected late in the season (October 20–25) the fibrils have many of them dropped from all vines, the difference in favor of the healthy vines points quite plainly to the fact that root absorption has been stopped earlier where the disease is present. This early stoppage of the action of the rootlets may account for the peculiar coloring of the leaves and failure of the canes to mature their wood.

As will be seen from the following somewhat free translation from Pierre Viala's work (The Diseases of the Vine, p. 432) the malady corresponds in many respects to what this eminent viticulturist calls *Rougeot* and which he considers a mild form of the destructive *Apoplexie* which has been long noticed in France.

Grape leaves sometimes suddenly assume a red color, especially in midsummer at the heated periods when there are strong dry winds or when the temperature falls suddenly. The leaf tissues become leathery and fragile between the veins, and the color, which normally would be that of a dead autumn leaf, is a bright, almost rose red and at times a wine color, while the veins remain green or yellowish, later the color becomes dull and the leaves dry up.

The yellowish shoots dry up, beginning at their bases. But the vine is not diseased beyond recovery as is the case with Folletage. It puts out green branches in the course of the same year and in the following year the only evidence of the disease is a slight weakness of the vine.

G. Foëx, in his Complete Course of Viticulture,* thus describes under the same name a disease which he considers somewhat distinct from *Apoplexie* or *Folletage :*

Rougeot is a disease which resembles Folletage in the conditions which cause it as well as in its general effects. Like this, it attacks the vine while it is in full growth, at the first heated period, and prevails especially in deep and cold soils.

Thiebaut de Berneaud† says that it is produced during the summer after a cold rain, a storm which suddenly lowers the temperature, or even a fog, when these are succeeded by warm south winds.

M. Mares‡ gives the following description :

"The leaves change, becoming like parchment, and lose their flexibility; the tissue between the nerves becomes red, while the nerves themselves remain green, giving the leaves of diseased vines quite a peculiar appearance; the berries shrivel, the canes remain yellow, and if the malady becomes more severe the leaves dry up entirely and the canes partially die—rotting from the extremity to the base. A vine is sometimes attacked only upon one side, which becomes brown, while the other parts remain green. * * * The vines diseased with rougeot do not die, as in the case of apoplexie, but are much injured, and their natural fertility is considerably diminished, only recovering after several years. Drainage appears to be, as in the case of apoplexie, the best means of diminishing the chances for the development of this malady."

While the above descriptions contain many conflicting statements it is reasonably certain that the malady seen by the various authors is the same and is probably of a like nature to the one in question. Viala in his *Mission Viticole en Amerique* mentions folletage, of which he considers rougeot a mild attack, as occurring in the Atlantic States, especially in the South.

A careful microscopic examination of all parts of the diseased vine has revealed absolutely nothing of the nature of a parasitic fungus which could in any way be connected with the malady. Leaves, canes,

* Cours complet de Viticulture, par G. Foëx, Paris, 1888, p. 421.

† Nouv. Manuel complet du Vigneron français. Manuels Roret, p. 186, quoted by Foëx.

‡ Des Vignes dans le Midi de la France in le Livre de la Ferme, Paris, Masson, 1865, p. 173, quoted by Foëx.

and roots seem perfectly free from any form of parasitic plant or animal. However, as this examination was only made late in the season, the decision as to the presence of parasitic organisms can not be considered as final.

CAUSES.

On the other hand, circumstances in this case as with the disease in France point to a close relation between the diseased vines and the condition of the soil with regard to drainage. In general it may be said that the worst attacks of the disease occur upon cold, heavy soils containing a large percentage of clay and rich in nitrogenous matters. Of the nine vineyards visited, which were over three years old from planting, seven showed the disease badly, and of these five were not underdrained and the remaining two only partially so. In the two vineyards which were upon high, well drained land the trouble was present only in its mildest form, in fact the attack was so slight that the owners had not noticed it. In one vineyard two adjacent plots, one cultivated for years as the family garden, the other in the regular farm rotation, showed a most striking contrast. The garden plot, although situated nearer the base of the slope, showed no signs of the trouble, while the plot in regular rotation had most of its vines badly diseased. Notwithstanding these facts, however, in particular vineyards the appearance of diseased vines upon its most elevated portions showed the disease was not wholly confined to cold, deep soils.

So far as the investigation goes there seems to be no connection whatever between the fertilizers used and the trouble, diseased plants being found upon land unmanured, heavily manured, fertilized with phosphates, wood ashes, and bone dust. In all cases the soil, although not chemically examined, seemed to be rich in nitrogenous matters and was fertile in every sense. It seemed, however, to lack one element, lime, which had not been applied and was evidently not abundant.

SUGGESTIONS IN REGARD TO TREATMENT.

In cases where the soil is at all inclined to retain more moisture than necessary, thorough underdraining will probably be the surest means of preventing a second attack. Should the vines show no mature wood available for the next year the better plan will be to prune close to the ground and raise an entirely new growth. Where the attack has been slight and enough mature wood remains to grow new bearing canes another season, such severe treatment is not necessary.

In any case, the pruning should be postponed as late as possible in order to give the canes that are still green all possible opportunity to ripen. The diseased vines should not be allowed to bear heavily the coming season, as the necessary strain may favor a second attack of the disease. Further investigations are, of course, necessary to ascertain more definitely the immediate cause of all such maladies.

BLACK ROT.

The presence of this disease was noted in all the counties visited, but its attacks this season have evidently been slight as compared with its ravages farther south, only an occasional cluster being attacked. That the malady has gained a foothold throughout this section can not be doubted, but timely applications of the copper mixtures will, if early undertaken, prevent severe ravages in future seasons.

ANTHRACNOSE.

Found sparingly at Fair Haven, Lyons, and Romulus, where it had damaged the fruit principally, only an occasional cane being affected.

DOWNY MILDEW.

This disease appears to be one of the worst pests of the New York vineyardist, presenting itself in the form of gray rot or brown rot in most of the vineyards visited, but as far as seen doing only slight damage to the foliage.

POWDERY MILDEW.

Numerous cases of this fungus were seen in almost every vineyard examined, except those sprayed with some of the copper mixtures. The fruit where attacked becomes discolored, and accumulations of dust which can not be removed occur upon the diseased portions rendering the clusters unfit for market.

GRAPE GLŒOSPORIUM.

This disease,* to be described in another number, although a new one, should be carefully looked after. It was noted in every packing house visited, and although any of the copper remedies would doubtless check its ravages it is likely to prove a troublesome pest.

GRAPE CLADOSPORIUM.

Upon two vines of Clinton in Cayuga County the immature stage of a species of *Cladosporium* was noticed in connection with powdery mildew. The berries attacked assumed a dirty orange-yellow hue, became rough and unsightly, and were ruined for market purposes. It is hoped that the mature spores of this fungus may be found and the species identified, but as yet only the mycelial form has been seen forming a thick felt composed of much torulosed mycelium upon the epidermis of the berry.

*Ann. Report, 1890.

ANTHRACNOSE OF COTTON.*

(Plate IV.)

By E. A. Southworth.

This disease, like others of the same name, is exceedingly destructive to the plants which it attacks and is caused by a fungus resembling the Glœosporiums. The presence of dark colored setæ among the spores and basidia separates it from the genus *Glœosporium* and makes it a *Colletotrichium*, but the general character of the fungus, so far as its effect on the host is concerned, is very similar to that of the Glœosporiums, well known as Anthracnose of the grape and raspberry. In the cotton fungus the setæ do not at first develop in any numbers, but become very numerous as the fungus grows older.

When the fungus was first brought to our notice, some immature specimens were sent to Mr. Ellis, who afterwards sent them to Mr. Cooke; both agreed that they were identical with *Glœosporium carpigenum*, Ck. & Hk., and the fungus was distributed in Ellis's North American Fungi under this name. Through the kindness of Professor Harkness I have recently been enabled to compare it with type specimens of *G. carpigenum*, and find it quite distinct from this fungus. *G. carpigenum* is a true *Glœosporium* with no setæ and the fruit borne in isolated pustules. The spores are also much smaller than those of the cotton fungus. These characters, as will be seen further on, separate the latter from *Glœosporium carpigenum* and the possession of setæ places it in the genus *Colletotrichium*. There seems to be no record of any specific name ever having been given it and I will call it *Colletotrichium gossypii*.†

EXTERNAL APPEARANCE AND EFFECTS ON THE BOLL.

According to Mr. Atkinson, who has observed the disease in the field, the fungus attacks all parts of the plant. It has been sent to us, however, only on the boll, and this description must therefore be limited.

So far as can be judged from specimens that have been picked from

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* Since this article was prepared, Professor Atkinson read a paper on the same subject before the Association of American Agricultural Experiment Stations at Champaign, Ill. The work in both cases was entirely independent, except where I have cited Professor Atkinson's authority in regard to the parts of the host plant attacked.—E. A. S.

† *Colletotrichium gossypii*, n. s. On cultivated cotton, may occur on any part of the plant, especially injurious to bolls. Sori orbicular, dark colored, or covered with a pink powder. Acervuli erumpent, distinct only when young. Spores irregularly oblong, usually with a light spot in the center, often acute at one end, colorless singly, flesh-colored in mass, borne on short basidia or long setæ. Basidia colorless varying in length, at least longer than the mature spore, very rarely branched, borne on a stroma of varying thickness, 11–28 x 5μ. Setæ occurring singly or in tufts, more abundant in older specimens, dark brown at base, but nearly colorless at the apex, septate, often irregular in outline, straight or flexuose, rarely branching, often bearing spores. Mycelium septate, intra and intercellular, usually colorless, producing secondary dark colored spores, especially when it has simply the form of a germ tube. Stroma of varying thickness, often penetrating the plant tissues for some distance, becoming dark colored with age or where setæ are borne.

one to five days and sent through the mails, the external appearance and progress of the disease on the boll is as follows:

One or more dark colored spots make their appearance on the green capsule. These increase in size and usually become covered with a flesh-colored powder for a short time. This is likely to disappear later leaving a poorly defined spot from which a blackish discoloration, often showing little spots of the pink powder on its surface, extends over the boll. The black discoloration may reach a considerable extent before the spot becomes pink at all, and judging from the appearance of some of the bolls it would seem as if the black color sometimes appears independently, without the pink spots. The growth of the capsule ceases wherever the discoloration extends; this causes the segments to crack apart through the diseased areas, leaving the half-ripe cotton exposed to the rain and dew as well as to the attacks of numerous insects. The capsule itself loses its power of resisting moisture and often becomes water-soaked and covered by saprophytic fungi. The saprophytic fungi, as well as the fungus causing the disease, often penetrate the cotton mass itself and the exposed portion becomes covered with a pinkish powder or with the white filaments and fruit of the saprophytes. As might be expected under these untoward circumstances, the cotton, and often the seeds as well, decays very quickly, especially if wet weather follows and if the bolls are attacked when young. If, however, they do not become diseased until they are nearly ready to burst open, and the weather remains dry, they may not be materially injured.

BOTANICAL CHARACTERS.

The vegetative portion of the fungus is branching and septate (Fig. 6), usually colorless, but sometimes showing a little darkening of the walls, of varying diameter, but usually about 5 μ. The mycelium penetrates the cells, often showing a constriction where it passes through the walls, with a slight enlargement on one or both sides (Fig. 5.). Frequently a hypha runs along in contact with the wall for some way before it pushes through. The mycelium is exceedingly abundant in the tissues, and sometimes appears to nearly fill the cells. In consequence of its presence the cell contents become disorganized and the cell walls frequently collapse, especially near the surface, where a section through the diseased tissue shows no cavities remaining. The chlorophyll is at first resolved into bright green globular masses, but later all the green color disappears, leaving only a small quantity of disorganized brownish material in the cells.

Anywhere in its course the vegetative mycelium may send off branches which push out to the surface and bear spores at their free ends. A quantity of these are generally sent off close together and become so matted at the surface of the boll that a stroma is formed from which spring the ends of the spore-bearing branches or basidia. This stroma varies very much as regards quantity; it may be a scarcely perceptible layer, or it may extend for some distance above the surface and pene-

trate between the cells for three or more layers (Fig. 3), completely surrounding the discolored cell fragments that remain, probably because the fungus is not able to absorb them. In older specimens the fruit is not borne in distinct pustules, but the epidermis seems to be broken up into flakes and the basidia are borne uniformly or in tufts on the fruiting surface. In the course of from two days to a week after the first basidia and spores are formed the dark brown setæ may be formed among them. They grow out from somewhat enlarged darker cells in the stroma, and are bluntly rounded at first, but become more acute as they grow older. They are frequently enlarged or present other irregularities somewhere along their course, especially near the tip (Fig. 1 *a*). The bases are a very dark brown, but the tips are usually nearly colorless. Under some conditions, especially in a moist atmosphere, the setæ may bear spores at their tips. These spores seem to be somewhat smaller than those borne on the regular basidia, but in artificial cultures the two kinds are indistinguishable. At first the setæ are few, but they increase in number with the age of the fungus, and in some sections the conclusion that the basidia themselves are being transformed into setæ is almost irresistible. In older specimens the setæ appear in large tufts and sometimes branch. It is not infrequently the case that one seta arises from the lower end of another; a beginning of this may be seen in Fig. 1. The amount of stroma is also seen to increase with age, especially beneath the setæ, where it becomes very dark colored. In old specimens the setæ are borne considerably above the basidia, so that the latter line the cavities between them (Fig. 1). The tufts of setæ may even have the appearance of being pushed up and out of the way by the basidia and spores behind them.

The spores are oblong, and usually have a vacuole in the center. Viewed separately under the microscope they are colorless, but in masses they form a salmon-pink powder which gives the color to the spots as already described. They are successively abscised from colorless basidia, which vary greatly in length and may branch when kept excessively moist (Figs. 4–7). Usually the connection between the spore and the basidium becomes smaller until the spore is cut off; but there are cases where the spore falls from the end of the basidium when the septum separating them is half as wide as the basidium itself, which appears truncate after the spore has fallen. The setæ which have borne spores also often have a truncate appearance.

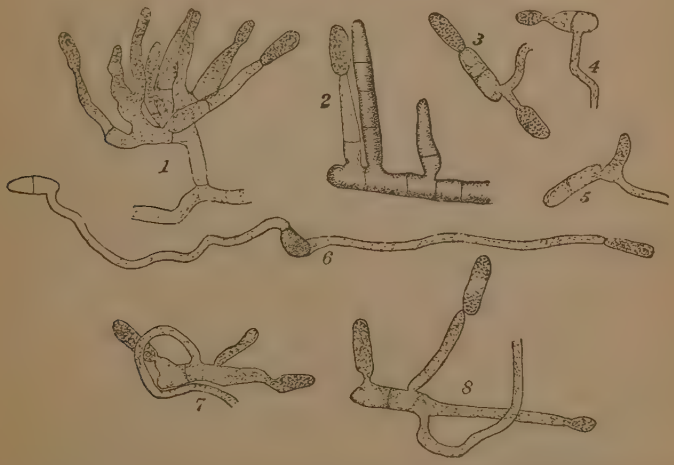
The fungus retains its vitality under very adverse circumstances. Some specimens of diseased bolls were allowed to lie in the heated air of the laboratory for a month or more. The pink spore powder was then entirely washed from the surface, a piece cut out and soaked, and placed under a bell glass. In three days the surface again showed small masses of pink spores that had been produced since the fungus was put under the bell glass.

An attempt was made to grow this fungus in a decoction of hollyhock agar-agar. This was only a partial success, for while spores and setæ

were produced the fungus was evidently in an unfavorable medium and was short-lived. However, some very important results were obtained.

In forty-three hours from the time of sowing, a distinct mycelium had been formed which bore numerous basidia at right angles to its branches and these were already producing spores (Fig. 7 b). Along with these spore-producing branches were others which differed from the basidia and ordinary mycelial branches in being devoid of visible granular contents, and on close inspection seemed to be a trifle darker colored and thicker walled. They sometimes had a septum near the base and were shaped like setæ. Twenty-four hours later there were well developed setæ on the same mycelium that bore the basidia and spores. As the mycelium grew older more setæ made their appearance; but in the moist environment in which it was necessary to keep the artificial substratum nearly all of them bore spores and were even more irregular in appearance than they are in nature.

After the setæ begin to form it is difficult to find basidia and setæ close together. The parts of the mycelium that bear setæ bear nothing else. Septa are often produced in the mycelium at each side of the bases of the setæ and the cell thus formed sometimes grows larger and darker colored than the remainder of the filament, while the threads which bear setæ are often coarser and darker colored throughout. This may explain the dark colored cells at the bases of the tufts of setæ as they occur in nature.



1. Tuft of basidia, with young spores rising from a single thread, showing mode of formation of fruiting surface.
2. Basidium and seta springing from the same mycelial thread.
3, 4, and 5. Spores twenty-four hours in water, showing spores produced by budding.
6. Germinating spore, with germ-tube and secondary spore, which in turn has sent out a germ-tube bearing a spore at the end.
7 and 8. Spores forty-eight hours in water.

Spores were also sown in a decoction of cotton bolls in agar-agar. In this the fungus grew more luxuriantly and rapidly, but was much slower in producing setæ, and when these were first discovered, nearly a week after they were sown, they were already bearing spores. For the first few days only colorless basidia could be found. When a spore was produced on this mycelium it was cut off from the end of the basidium and another formed on the same place, pushing the former one aside. This may occur until there is a large collection of spores at the end of the basidium, the spores that are pushed aside lying adjacent to the second one along their entire length (Fig. 7).

When spores are sown in pure water they exhibit a phenomenon which can scarcely be called anything but budding (Figs. 1–5, 7, 8, p. 103). They become once septate, and while one division sends out a germ tube the other gives rise to another spore, separated from the first only by a short neck. The germ tube also frequently sends out a spore just beyond the point where it leaves the spore (Figs. 3, 5, p. 103). By the time a spore has been two days in water the cell that at first gave rise to the germ tube may also have produced several spores, either by budding or upon a short thread.

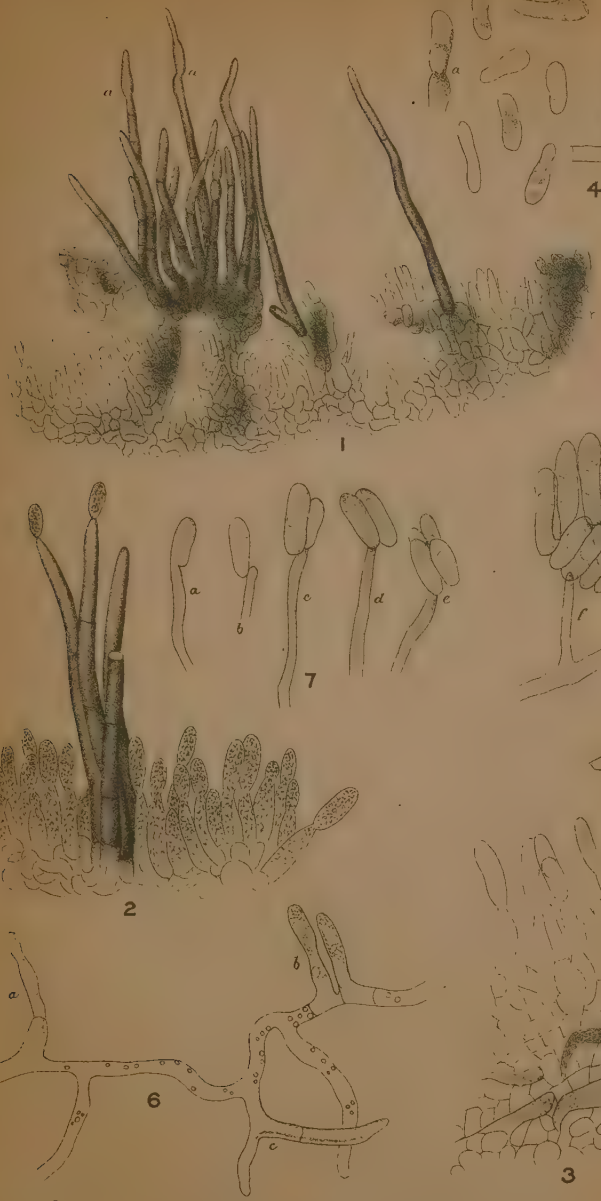
Secondary dark colored spores (Fig. 6, p. 103) are also often produced in great numbers both when the spores are germinated in water and in nutritive media. In the latter they are sometimes so abundant as to give the mycelium a dark color when seen by the naked eye. These bodies are usually regular at first, but become very irregularly lobed and even reproduce themselves by constriction. They also give rise to other mycelial filaments. I do not understand their special function.

GENERAL NOTES.

Just how long the disease has existed or has been a source of trouble to cotton growers can not well be ascertained: but those who have written us concerning it speak of it as new, and it is safe to say that it has greatly increased in destructiveness during the last three years and has now become a source of danger to the cotton industry.

It was first brought to our attention in the summer of 1888 by a letter from a cotton grower in Louisiana. Last year, we received no complaints in regard to it, but during the last few months repeated inquiries have been sent in, and in two cases, one from Alabama and one from Louisiana, it is reported as destroying 75 per cent. of the crop. In general, however, it seems to destroy from 10 to 25 per cent. The disease is evidently not a new one, as a specimen dating back five or six years has been found in the Department herbarium. In this case, however, only a saprophytic fungus which had nearly overgrown the true cause of the trouble was named on the label.

It seems to have appeared at first on the improved varieties and is worse in wet seasons. That it is widespread is evidenced by the fact



E.A.S. del.

SOUTHWORTH ON ANTHRACNOSE OF COTTON.

Colletotrichium gossypii, n. s.

that it has been reported to us from Arkansas, Louisiana, Indian Territory, and Mississippi.

From the nature of the disease there is every reason to fear that it will be very difficult to prevent by fungicides. Anthracnose of the grape is more obstinate than black-rot, and no well defined, certain remedy is yet known for it. The treatment of anthracnose of beans and melons has been attempted on a small scale and has failed completely. The hollyhock disease has been only partially prevented by the use of fungicides that would have succeeded perfectly with black-rot of grapes or leaf-blight of pear. In some of these cases, however, a partial success has been attained and the indications are that the proper use of Bordeaux mixture may finally conquer even this type of fungus.

The vitality of the fungus as shown by its reviving after drying, and the power of the spores to reproduce themselves, are very sure indications of one mode of preventive treatment, viz, the removal from the field of all diseased bolls as soon as possible. A worthless boll will be likely to produce fresh spores with every rain, and if left over winter in the field will probably prove a source of infection the following season, for each spore is capable of infecting a fresh boll. One infection experiment was made on three healthy bolls. The spores were inserted in a cut and the fungus was produced in great quantities all around the cut. The value of this experimment was lessened by the fact that the fungus also appeared on one of the check bolls and that all were taken from a field in which the disease was present. The fact, however, that on the infected bolls the fungus was confined to the vicinity of the cuts is evidence that it was caused by the inserted spores.

Plans are being made to test the value of fungicides in checking this disease during the next cotton-growing season.

EXPLANATION OF PLATE.

Colletotrichium gossypii, n. s.

Fig. 1. Section through old fruiting layer, showing the setæ borne on dark-colored cells, above the level of the basidia; *a a*, enlargements of setæ near the end. X 360.

Fig. 2. Section through younger portion of fruiting layer. Two setæ bearing spores. X 600.

Fig. 3. Section showing stroma mixed with tissues of the boll. X 800.

Fig. 4. Spores; *a a*, borne on basidia. X 600.

Fig. 5. Filiament of mycelium passing through cell wall. X 800.

Fig. 6. Portion of artificial mycelium bearing setæ at *a* and *c*, and at *b* basidium with immature spore. X 600.

Fig. 7. Different stages in the formation of spores in artificial culture. X 600.

PERENNIAL MYCELIUM OF THE FUNGUS OF BLACKBERRY RUST.*

Plates V, VI.

By F. C. Newcombe.

In May of the present year, at the suggestion of Mr. Galloway, a plant of *Rubus villosus* affected with *Cæoma nitens*, Schw. was examined with a view to ascertaining whether there is a perennial mycelium.

A shoot of the blackberry was selected whose lowest leaf bearing the rust was 16 centimeters from the rooting portion of the stem. Beginning with the leaf, cross and longitudinal sections were made, at intervals of 2 centimeters, down to the roots.

At every place of section the characteristic mycelium was found. In one instance the mycelium was observed in the medullary rays; in every other case in the pith only. It is septate, intercellular, and coarsely granular. It looks active and vigorous in the old stem as well as in the green shoot. But the most striking part of it is the haustoria. These are found of the same appearance in leaf, green shoot, and old stem. Penetrating the cell wall by a narrow neck, in the cell-lumen a haustorium expands to a large, lobed and knotted, club-shaped body whose diameter exceeds that of the mycelial filament and whose length frequently attains the transverse diameter of the host cell. In longitudinal sections the mycelium can be followed for long distances in the direction of the shoot axis, not often branching laterally, but sending its great haustoria in all directions into the adjacent cells of the host. Not infrequently the mycelium is seen to form a pseudoparenchyma in the intercellular spaces.

These observations were repeated on fresh material gathered near Ann Arbor the latter part of June.

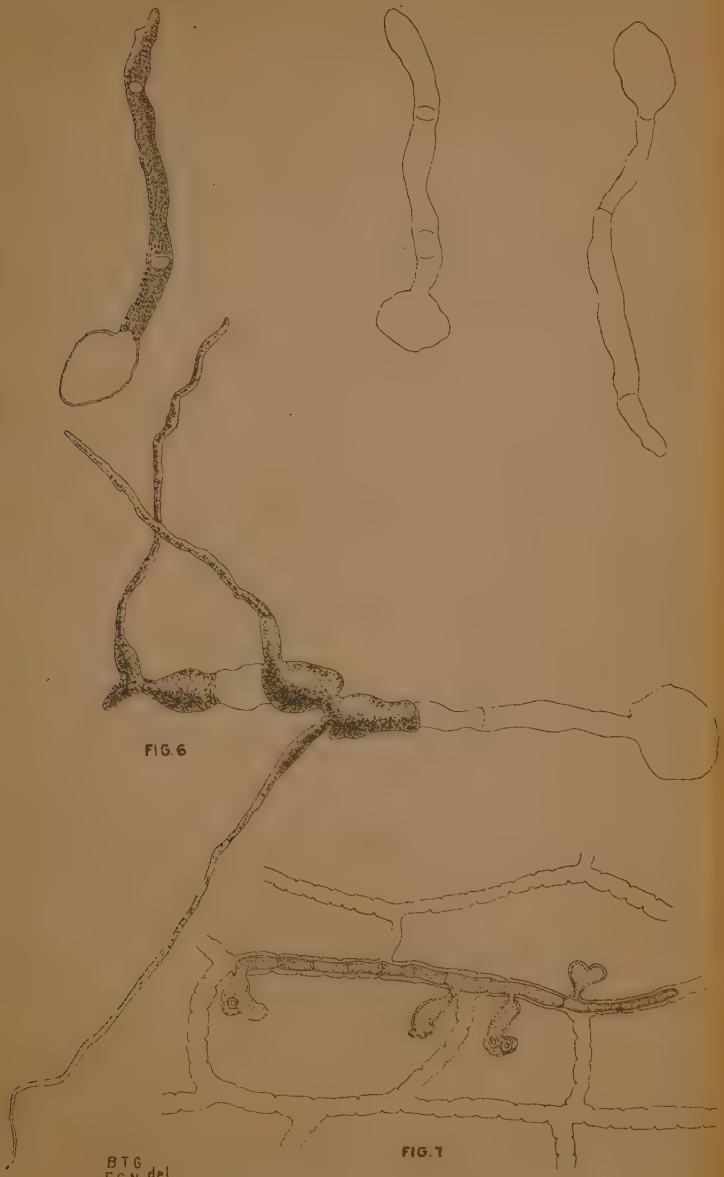
NOTE BY B. T. GALLOWAY.

Mr. Newcombe's observations have an important bearing on the treatment of blackberry rust, as they indicate that no direct benefit would result from the application of fungicides. Some writers† have claimed that the fungus does not live over winter in the root and stems, and if this were true it would seem possible to prevent the disease by the timely application of fungicides. Field experiments have shown that such applications, no matter how carefully made, have little effect so far as diminishing the amount of rust is concerned.

It is obvious that the immense number of spores, which form the reddish powder so familiar to every one, plays an important part in the life history of the fungus, and by destroying these spores, spraying may, indirectly, result beneficially. It is doubtful, however, if spraying with this object only in view will pay in the end. After all, it seems that

* *Cæoma nitens*, Schw.

† Burrill, Prairie Farmer. 1885, p. 762. Seymour, Rept. State Hort. Soc. Minn. 1886, p. 214.



NEWCOMB AND GALLOWAY ON BLACKBERRY RUST.
Cæoma nitens. Schw.

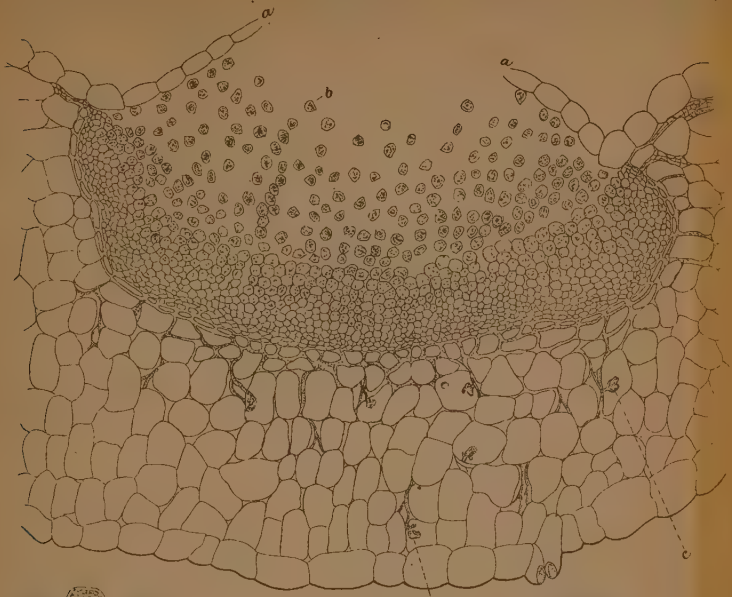


FIG. 1

FIG. 3

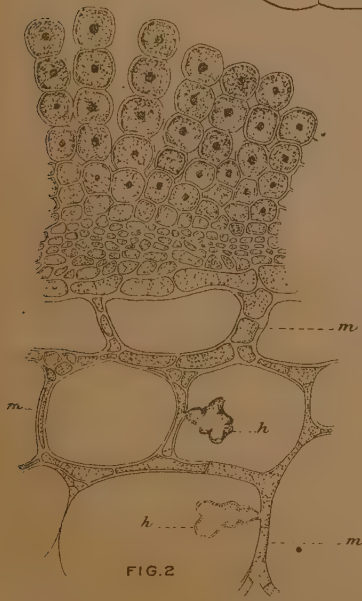


FIG. 2

FIG. 4

F.C.N. del.

NEWCOMB ON BLACKBERRY RUST.

Cæoma nitens. Schw.

the only practical and efficient method of dealing with this pest is the old one of grubbing out the affected plants as soon as they are noticed. It would be well, also, to discard those varieties known to be subject to the trouble.

EXPLANATION OF PLATE.

BLACKBERRY RUST (*Cœoma nitens*, Schw.).

Fig. 1. Section through portion of leaf affected with rust; *a a*, ruptured epidermis showing below at *b* the mass of spores; *c c*, haustoria. By means of these the fungus draws its nourishment from the cells. X 100. Newcombe.

Fig. 2. Part of section more highly magnified; *m m m*, mycelium surrounding cells of the host; *h h*, haustoria projecting within the cells. X 300. Newcombe.

Fig. 3. Spores. X 600. Newcombe.

Fig. 4. Section through spermogonium. X 300. Newcombe.

Fig. 5. Spores germinating; 24 hours in water. X 250. Galloway.

Fig. 6. Spore germinating; 60 hours in water. X 300. Galloway.

Fig. 7. Section through piece of old underground stem, showing perennial mycelium and haustoria. X 300. Newcombe.

FIELD NOTES—1890.

By Erwin F. Smith.

The field naturalist often discovers interesting phenomena not immediately related to his own work—phenomena too fragmentary to be worked up separately, and yet sometimes of much value to others if accurately observed and duly recorded. Such must be my apology for the greater part of the following "notes by the way."

PEACH-LEAF CURL.*

Heretofore, in this country, California orchards are the only ones that have been seriously affected by this widely distributed fungus. This spring, however, it caused great injury in certain districts east of the Mississippi River, and was more than usually prevalent in all the principal peach regions of the eastern United States. It was most destructive in central Michigan and western New York, defoliating trees by the thousand in both localities. By the last of June the fungus had nearly disappeared, and the trees had partially recovered and were clothed with a second crop of leaves. But even in July the effects were plainly visible in enfeebled growths, yellowish foliage, and stunted fruits. Certain varieties suffered much worse than others, *e. g.*, Crawford's Early. It seemed to me it would take some of the trees several years to recover.

In Delaware and peninsular Maryland the fungus was unusually common, but the orchards were not defoliated nor badly attacked. I also observed traces of the disease in Georgia in midsummer, but it did not appear to have attracted attention or caused serious injury.

* *Taphrina deformans*, Tul.

During 1887, 1888, and 1889, this fungus was rare in the great peach region between the Chesapeake and Delaware Bays. Often weeks passed without my seeing a single affected leaf, although I spent much of my time in the orchards. This struck me the more forcibly because in Michigan I had formerly observed the curl to be common every spring. This season, on the contrary, it could be collected in any peninsular orchard. In one only, however, did I find it serious. This was an old, abandoned orchard in sod ground, pastured. Here in May nearly every leaf was white, thick, and distorted, and many were falling. At a distance the foliage was not green, but yellowish white. Younger cultivated orchards on the same farm were nearly free.

PLUM TAPHRINA.

In Maryland and Georgia this disease was also very prevalent on *Prunus Chicasa* and its cultivated varieties. I have been accustomed to call this fungus *T. pruni*, but the injuries differ somewhat from those I have seen on *Prunus Americana* in the North and West. This fungus is much more inclined to thicken, distort, and unite the leaves and growing shoots. The "plum pockets" are also absent. The fruits often suffer, but the fungus generally attacks only one side, forming a hard, solid spot, which ripens imperfectly. From what I saw in the plum orchards of Georgia, and was told, this fungus is an enemy of some importance in that region. Is it specifically distinct from the pocket forming sort?

PLUM BLIGHT.

A peculiar disease, now prevalent several years, in a large plum orchard of native sorts at Griffin, Ga., deserves further study. This disease destroys large branches or whole trees in midsummer in the course of a few weeks. I saw many fine trees of bearing age entirely ruined. The foliage was drying up as if scorched, or as if the limb or body had been girdled. No fungous or insect enemies were observed, and there were no mechanical injuries. The surface bark on the trunk and base of the main limbs was smooth, unbroken, and usually normal in appearance, but upon cutting into it I always found large dead patches which sometimes entirely girdled the trunk or branch. These were often several inches wide by 1 or 2 feet long. Evidently the sudden drying and death of the remoter parts is due to interference in the circulation brought about by the presence of these bark injuries. Their origin, however, is still a mystery. There did not appear to be any injuries below ground. Indeed the injured trees usually sprout again vigorously from the earth.

The loss this year in an orchard of about 6,000 bearing trees amounted to more than 5 per cent. The owner said 10 per cent. The loss last year was nearly as great.

APPLE BLIGHT.*

Never before have I seen this disease one-tenth part as destructive. In middle and north Georgia the apple trees were badly spotted by it. The injury was not confined to twigs, but affected branches of several years' growth, greatly injuring next year's fruit prospect. The disease was also common in Pennsylvania, where in other years I have found it common, although confined principally to the twigs. In Michigan it was not seen. In Kansas it was worse even than in Georgia. At Manhattan I was shown several young and thrifty orchards of bearing age which had been sadly injured. The attack began in 1889 and continued this year with increasing severity. The disease was not confined to twigs, but often destroyed large limbs and in some cases one-half or even the whole of the tree, as in pear blight. The owner was in despair. Certain varieties were noticeably worse injured than others. This was found to be true for different orchards and both years. Certain sorts escaped almost entirely.

PEAR-LEAF BLIGHT.†

In Dr. W. S. Maxwell's orchards the Lawrence and Bartlett pears in *sod* ground were very slightly attacked. They held their foliage practically intact until October 15. The cultivated trees were badly affected and shed their foliage early, except Keifer, which did not suffer. I observed this fungus at Still Pond, Md., in 1887, in these same orchards and elsewhere, and also in other parts of the peninsula, but it was not destructive and was not then considered of any consequence by any of the pear growers. Now they are all talking about it.

This year quince and pear orchards all over the Delaware and Chesapeake peninsula were seriously defoliated, and, as a consequence, were quite commonly in second leafage and blossom in October. The injury last year was also very great, amounting in some large orchards to an almost total loss of the crop.

BLACK ROT.‡

In Georgia and Kansas the summer was hot and dry. Vineyards in both States ripened a large and fine crop of fruit, which was almost free from rot. Enough *Læstadia* could be found for specimens, and the same was true for *Peronospora viticola*, but neither did any injury.

In Delaware there was also a long drouth in midsummer and black rot was not seriously destructive.

VINE BLIGHT.§

In good soil in one corner of a fine bearing vineyard near Griffin, Ga., twenty-five or thirty thrifty vines suddenly sickened in midsummer and

* *Bacillus amylovorus*, (Burrill) Trev.

† *Entomosporium maculatum*, Lév.

‡ *Læstadia Bidwelli*, (Ell.) V. and R.

§Later this blight was attributed to lightning, by the owner and others, who said lightning had also caused a similar appearance in the cotton fields.

died, in whole or part, in course of a few weeks, without apparent cause. The foliage lost color and wilted, the clusters shriveled, and the canes turned black. No fungous or insect enemies could be seen.

The vines were trained up on stakes and the vineyard had received proper care and cultivation. The soil was well drained upland. The cases were not all in one spot, but scattered about. The malady in its sudden appearance and destructive nature called to mind the mysterious vine disease of California, but did not agree with it in all particulars. At my suggestion the vines were promptly removed and destroyed.

BROWN ROT OF THE PEACH.*

Owing to the phenomenal scarcity of stone fruits in peach districts east of the Mississippi, this fungus was rare, except on old fruits. I saw it once at Lansing, Mich., on nascent plum shoots, but not elsewhere.

PEACH YELLOWS.

In southwestern Michigan there was an increase of the disease around Fennville, but not elsewhere, so far as I could hear or observe.

On the Delaware and Chesapeake peninsula this disease was worse than any previous year. The marked diminution of new cases in 1889 was coincident with a partial failure of the crop. It therefore seemed possible that here might be a clue to the cause of the disease. This year, however, with an entire failure of the crop the number of new cases were in excess of those in 1886, 1887, or even 1888, when the orchards bore most abundantly. Fruit or no fruit, the disease increases.

The cases by years in four representative Delaware orchards (my own count) are as follows:

Year.	Weather in summer.	Cases.			
		30 acres set in 1882.	10 acres set in 1885.	2 acres set in 1884.	10 acres set in 1884.
1887	Wet	†260	132	136	127
1888	Dry	314	71	47	54
1889	Wet	255	63	0	37
1890	Dry	856	118	90	87

* A very few cases belong to 1886 when the disease first appeared. † First cases

THE PEACH ROSETTE.

A new peach disease, or an old one in a new form, has made its appearance in Georgia and Kansas and bids fair to become very serious. One Kansas orchard was destroyed in two years, and certain Georgia orchards have suffered almost as badly. In some particulars this disease is identical with peach yellows; in others it differs somewhat. The disease occurs also in plums, wild and cultivated, and is equally destructive. A full account is reserved for separate consideration.

* *Monilia fructigena*, P.

THE RELATIONSHIP OF PUCCINIA AND PHRAGMIDIUM.

By Prof. G. de Lagerheim.

As a distinctive difference between Puccinia and Phragmidium, Tulasne* asserts that the teleutospores of the first genus are only provided with one germ pore, while those of the second possess several which are equatorially arranged. Since then, however, Dietel† has shown that this is not the case in all Phragmidiums, but that in *Ph. obtusum*, Winter, each cell of the teleutospore is provided with only one germ pore situated at the upper end of the cell exactly as in the genus Puccinia. *Ph. abidum*, Ludwig, appears to form a transition between the two types.‡ It should also be mentioned that in *Ph. Barnardii*, Plowright & Winter, and in *Ph. carbonarium*, Winter, the end cell is provided with an apical pore. Besides these characteristics, which are, as we see, unreliable, *Phragmidium* is distinguished from *Puccinia* by the number of cells in its teleutospores and by the different structure of its *Ecidia*. But in several Puccinias we occasionally find many-celled teleutospores, and therefore this character is not constant. On the contrary the difference in the structure of the æcidium appears to be a constant mark of distinction. The æcidium of Puccinia is provided with a pseudo-peridium, while that of Phragmidium is not; and in the latter the spores are cut off from basidia and surrounded only by a row of paraphyses as in the genus Melampsora.§

In the above-mentioned work Dietel has attempted to establish the the fact that *Phragmidium* is more closely related to *Chrysomyxa* than to *Puccinia*. But in comparing the two genera which he considers to be related he has forgotten to notice the difference existing between their æcidia and uredo stages. As has been said, the æcidium of *Phragmidium* has no pseudo-peridium, while one is present in the æcidium of *Chrysomyxa*. The structure of the uredospores of the two genera differs even more. In *Phragmidium*, as in *Puccinia* and *Uromyces*, they arise singly at the end of a mycelial thread, while on the other hand in *Chrysomyxa*, as in *Coleosporium*, they are borne in rows. I am therefore inclined to believe in a closer relationship between *Puccinia* and *Phragmidium* than between *Chrysomyxa* and *Phragmidium*. This supposed relationship would become still clearer if one could find a *Phragmidium* with a Puccinia-æcidium or a *Puccinia* with a Phragmidium-æcidium or with several equatorial germ pores. We can probably regard the genus *Rostrupia*‖ as a *Phragmidium* with a Puccinia-æcidium. The teleutospores

* Ann. de Sci. Nat. Ser. 4, t. II, p. 146.

† Beitrage zur Morphologie und Biologie der Uredineen t. II, 9. Figs. 3–7. (Cassel, 1887.)

‡ Compare Dietel, l. c., t. II, Fig. 10, and Müller Die Rostpilze der Rosa und Rubusarten und die auf ihnen vorkommenden Parasiten t. I, fig. 9 (Berlin, 1886).

§ The genus *Calyptospora*, Kühn. is not to be united with *Melampsora*, because, as is known, the Calyptospora-æcidia have a pseudo-peridium.

‖ Compare Lagerheim, Sur un nouveau genre d'Urédinieés (Journ. d. Botan., 1889) Paris.

of this genus are as a rule 3–4 celled, and the uredospores are formed in the same way as in Phragmidium (and Puccinia). The æcidia of *Roestrupia* are unfortunately not known, but judging from its great similarity to certain grass inhabiting Puccinias it is very probable that the æcidia are formed as in *Puccinia* and *Uromyces*. A Puccinia with a Phragmidium-æcidium is not known, although it is not impossible that such a one exists. On the other hand there is one Puccinia, or perhaps several, which shows a condition of the germ pores typical for *Phragmidium*.

There are several *Uredineæ* on Barberry species. Besides the well known æcidium of *Puccinia poculiformis*, Wettstein (*P. graminis*, Persoon), there probably occur three æcidia upon Barberry, namely, *Æc. Magellhanicum*, Berkeley,* æcidium of *P. berberidis*, Montagne, and an æcidium which appears to belong to a *Diorchidium* frequent around Quito on *Berberis glaucа*. The genus *Uromyces* is represented on Berberis (Mahonia) by one species, *U. sanguineus*. Besides the above mentioned, *P. berberis*, Mont., two Puccinias, *P. mirabilissima*, Pk. and *P. antarctica*, Speggazzini, have been observed on Barberry. Finally two uredo forms are found on Berberis, namely, *U. æcidiiformis*, Speggazzini and *U. antarctica*, Speggazzini.

Puccinia mirabilissima was described by Peck in the Botanical Gazette for 1881, p. 226. Tracy and Galloway gave further information concerning it in the Botanical Gazette for 1888, p. 126, and De Toni gives the following diagnosis of the species (Syll. Ured., p. 620).

Maculis late purpureis 3-4 millimeter diameter, leniter inerassatulis, pseudoperidiis hypogenis, longis, pallide flavis, margine grosse laceratis; æcidiosporis subglobosis, 15-22 *u* diameter, tuberculatis; maculis parvis, punctiformibus vel majusculis subrotundisque, superne atris vel atrobrunneis; soris hypophyllis, paucis, minutis pallide rufescenti—brunneis; uredosporis subglobosis, obovatis vel piriformibus, obtusis, minutissime rugulosis; 22–33 by 20–23 *u* pedicello hyalino, dein deciduo; teleutosporis immixtis, ellipticis, obtusis, ad septum constrictis, subtiliter rugosis, 30–32 by 22–25 *u* pedicello longissimo hyalino fultis.

The species is found in several places in the United States on the leaves of *Berberis repens*, and has been distributed in Ellis's North American Fungi, No. 1451, and Rabenhorst-Winter-Pazschke's Fungi Europæi, No. 3619.

In the following I will give the results of my investigations with specimens distributed in Fungi Europæi. They were collected at Thompson Falls, Montana, September, 1884, by Seymour, and in Sierra Nevada, California, May, 1886, by Harkness. Uredo and teleutospores, but no æcidia, were present; the uredospores from the Montana specimens were more or less ovate, those from California piriform.† When treated with warm potash or lactic acid the epispore swelled up so

* [illegible] Shuttleworth, is really identical with it. *Magellanicum* Berkeley.

† Compare Lagerheim "L'acide lactique, excellent agent pour l'etude des champignons secs" (Rev. Mycol. No. 42). Toulouse. 1889.

that it could easily be shown to consist of three layers. The outer layer is very thin, colorless, and covered with fine warts; the middle layer is the thickest and is yellowish and smooth; the inner layer appears tolerably firm and is also yellowish and smooth. The uredospore is provided with from three to four equatorial germ pores, and the membrane is not equally thick everywhere, but is not especially thickened at the base of the spore. Treated in the same manner the epispore of the teleutospores showed the same three layers; the warts on the outer layer are somewhat larger and do not stand so close together as on the uredospores. The teleutospores are characterized by a long hyaline pedicel which breaks off at the base and remains in connection with the spore. The pedicel tapers below and is hollow in the lower portion. It is not perfectly smooth everywhere, but a small wart occurs here and there. Probably Peck called this species *mirabilissima* on account of the strikingly long pedicel, but it deserves this epithet in a still higher degree on account of another peculiarity that has been hitherto overlooked. One of the main characters of the genus *Puccinia* is, as we know, that each cell of the teleutospore is provided with but one germ pore which can have different positions, but in *P. mirabilissima* this is not the case, for here is each cell of the teleutospore with two opposite germ pores. These show plainly when the spores are treated as above mentioned. In this respect *P. mirabilissima* varies from all other Pucciniias that have been carefully observed, and even in this peculiarity I see a point of union between the genera *Puccinia* and *Phragmidium*. It would be of interest to study the germination of this peculiar species, and it is to be hoped that some one of my North American colleagues, to whom living specimens are accessible, will undertake it.

QUITO, ECUADOR.

NOTES.

A NEW PEAR DISEASE.

Something over a year ago we received from one of our correspondents in southern Alabama a number of pear branches affected in a peculiar manner. In a letter sent with the specimens our correspondent described the disease as follows:

> The disease appears in the form of spots on the trunk of the tree, always at a dormant bud, also on the branches at the base of another branch or fruit spur. The spots when first noticed were about one-quarter of an inch in diameter, but soon increased to four or five times this size. They are nearly round and are surrounded with whitish uneven edges. When one-half an inch or more in diameter the affected portion becomes depressed and upon cutting into it the bark cambium and a considerable portion of the wood is seen to be brown and dead. In no case has the affection entirely encircled a branch or trunk, but I have no doubt that if allowed to continue it will do so in a short time. I have never seen the disease before and fear it will prove troublesome in my orchard.

Upon examination of the specimens it was found that the disease was due to a fungus known as *Thelenhora pedicellata*, Schw. We have this

parasite, for so we must regard it, from New Jersey on oak (*Quercus cocinnea*), Florida on palmetto (*Sabal palmetto*), and Texas on cultivated apples. From this it will be seen that it is not particular as to hosts or locality. There is no doubt that on trees having such soft, tender bark as the pear and apple the fungus will readily obtain a foothold and prove a very serious enemy. An allied species (*T. perdix*, Hartig) occurs in Europe on oak, causing what is known as "partridge wood." In this case the wood becomes a deep brown; then white spots appear upon these discolorations, giving to the affected parts a mottled appearance, hence the name.

To our correspondent's inquiries concerning the cause of the disease and its treatment we gave in reply to the first question substantially what is stated in the foregoing remarks, suggesting by way of an answer to the inquiries concerning treatment that he cut out all the diseased wood and, after washing the wounds thoroughly with a saturated solution of sulphate of iron or copperas, apply grafting wax or something similar. Our suggestions were complied with to the letter, excepting that a coat of shellac dissolved in alcohol was used instead of grafting wax.

A few days ago we received a note from our correspondent saying that the treatment had proved entirely successful. The wounds healed readily and the trees which a year ago bore every indication of approaching death are now as vigorous as any in his orchard.—B. T. Galloway.

DISEASE OF GERANIUMS.

For a long time we have noticed a disease of geraniums which attacks the stems, causing them to turn black, shrivel, and sometimes become soft and mushy. The trouble is not confined to any particular variety, nor does it seem to be influenced to any great extent by soil or climate. It is a very troublesome thing in greenhouses, especially among cuttings, which it often destroys by the thousand. Cuttings attacked by the disease begin to turn black at the severed end, the discolorations rapidly extending upward until the whole stem is involved. Occasionally the disease stops after an inch or more of the cutting is destroyed; but even if this takes place the plant eventually dies as soon as the supply of nourishment in the green portion is exhausted. Cuttings rooted in the bench are not so apt to suffer from the disease as those immediately potted. The disease is also more troublesome where immature wood is used and when too much water is applied immediately after the cuttings are potted.

Microscopic examination of the diseased tissues has so far revealed nothing in the shape of a fungus excepting where the wood has become soft, where, as might be expected, a number of saprophytic forms occur. Sections through portions of the stem as at *a* Fig. 1, where the disease is actually at work, reveals under the microscope immense numbers of bacteria, in some cases almost filling the cells and often escaping into the water in sufficient numbers to make the latter appear milky.

Cultures made from the diseased wood on gelatine, agar-agar, potato, etc., usually show at the expiration of from 24 to 48 hours numerous colonies of bacteria which are for the most part of one kind, namely, a *Bacillus*.

As yet no inoculations have been made with the organism itself, but the disease has been produced in a number of cases by inoculations directly from diseased wood. Figure 2 shows the result of one of these inoculations, *a* being the point where the knife entered the tissue. The disease is one certainly worthy of careful investigation, as the losses in one establishment last year in this city amounted to over 50 per cent.

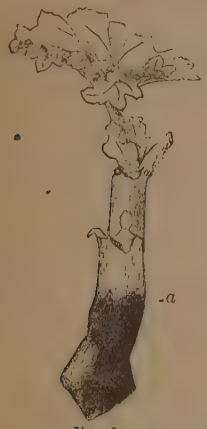


FIG. 1.

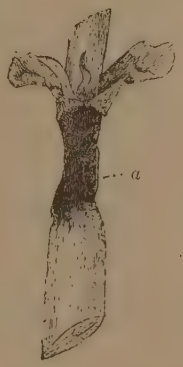


FIG. 2.

FIG. 3.

Our object in writing this preliminary note is to call the attention of florists and others directly interested in the matter to the work we now have under way and to obtain from them any information bearing on the subject they may consider of value.

A disease which may be the same as the one here referred to has recently been reported from France by Messrs. Prillieux and Delacroix.*

According to these writers *Pelargonium* and potato stems are affected with a malady which causes them to turn black and become rotten. The disease has been transferred from the potato to the *Pelargonium* and vice versa. A *Bacillus*, which the authors believe to be the cause of the trouble and which has received the provisional name of *B. caulicolous*, Pr. and Del., has been found associated with the disease. No mention is made of the disease having been produced by inoculating with the organism, although it is claimed that this can readily be done by direct inoculation.—B. T. GALLOWAY.

ADDITIONAL OBSERVATIONS ON ANTHRACNOSE OF THE HOLLYHOCK.

Since the last issue (Vol. VI, No. 2) of the JOURNAL OF MYCOLOGY some additional facts have come to light concerning the *Colletotrichium* on the hollyhock.

* Comptes Rendus t. CXI, p. 208.

A fungus exactly like it in appearance has been found on *Sida spinosa* by Mr. W. T. Swingle at Manhattan, Kans. Some attempts at producing the disease on hollyhock by the spores from *Sida* have been made, but as far as known they have not been successful. This might easily be accounted for by the lateness of the season and consequent low temperature, and it seems almost certain from a comparison of the fungi that they belong to the same species.

Dr. P. A. Saccardo writes that the fungus is probably not a new species at all, but was described in 1854 by Braun and Caspary as *Steirochæte naivarum* on *Malva* in Europe (Sacc. Syll., IV, 316). The descriptions certainly agree in many respects, but the description in the Sylloge reads, "Conidiis ex pseudostromate immediate (ut videtur) orientibus," and the spore measurements are given as 8–9 x 3–4 *u*. In the fungus on hollyhock there was no question as to the spores being borne on basidia and they measured 11–28 x 5 *u*. The fact of the spores being borne on basidia may, however, have been overlooked, and as the spores vary greatly anyway, the difference in size is not sufficient reason for making a new species.

After comparing the two descriptions it seems very probable that the fungus must stand as *Colletotrichium malvarum*, (Br. & Casp.).

There also seems to be a possibility that *Steirochæte graminicola*, (Ces.) Sacc. may be identical with *Colletotrichium bromi*, Jennings, an undescribed species on *Bromus secalinus*, noted in Bull. 9 of the Texas Experiment Station.—E. A. Southworth.

LEPTOTHYRIUM PERICHYMENI, DESM.*

Specimens of what seemed to be this species on *Lonicera*, sent this season from Perry Sound, Ontario, Canada, by Mr. Dearness, have the sporules (pseudo) septate near the lower end and agree accurately with the description and specimens of *Marsonia lonicerae*, Hark., except in being mostly shorter 22—30 x 7—9 *u*. European specimens in Thüm. M. U. 1893, Kunze, F. Sel. 591, Linhart 474 and F. G. 4674 do not show any septum, though the F. G. specimens show some indications of one. The European specimens also have the sporules less attenuated below. In the specimen from Dearness and Harkness the lower part of the sporule is so much narrowed as to appear like a stipe or pedicel. The Canadian and Californian specimens are certainly the same and can not be referred to *Marsonia*, as they have a very distinct scutellate perithecium of radiate fibrous texture. We propose to designate the American form as *Leptothyrium perichymeni*, Desm. var. *Americanum*, E. & E.—J. B. Ellis and B. M. Everhart.

A NEW USTILAGO FROM FLORIDA.

Ustilago Nealii, Ell. and Anders., n. s. On *Heteropogon melanocarpa*, Lake City, Fla. Prof. J. C. Neal, collector, 1890.

Attacking the inflorescence. Spore masses firm, blackish brown, fill

*Sacc. Syll. III, p. 626.

ing the ovaries, frequently transforming a whole spikelet into a solid mass of spores enveloped in a whitish to buff-colored tegument. The lower lateral solitary spikelets, when attacked, are changed into irregular roundish knots, or nodules, as large a medium sized pea. Spores roundish, oblong, oval or ovate and variously compressed; contents pale olivaceous, epispore smooth, reddish brown; general color of spore a bright warm brown, slightly olive tinged, 6–10 μ wide, by 6–14 μ long. J. B. Ellis and F. W. Anderson.

REVIEWS OF RECENT LITERATURE.

Kellerman, W. A., and Swingle, W. T.—*Preliminary experiments with fungicides for stinking smut of wheat.* Bulletin No. 12.—August, 1890. Botanical Department of the Experiment Station, Kansas State Agricultural College, Manhattan, Kans.

The wisdom of the recent establishment of State experiment stations by the General Government has been called in question in certain quarters. Nevertheless, the stations are here to stay, and their public usefulness becomes more and more apparent, especially after reading such a paper as this from the Kansas station. The results are striking and conclusive, and worth more to the wheat-growers of this country than the cost of all the stations.

In the main these experiments are a repetition and confirmation of those made in Europe by Jensen, Kühn, and others. Fifty-two treatments were given for the prevention of stone smut in wheat (*Tilletia*). The substances experimented with were:

Hot water of various temperatures; lye of different strengths; solutions of copper sulphate with and without lime, and of different strengths; Bordeaux mixtures, full and half strength; eau celeste; solution of sodium hyposulphite, with and without lime, and of different strengths; solution of potassium sulphide, with and without lime, and of different strengths; arsenic; lime; salt; soap; cistern water; chloroform; ether; sulphurous oxide; carbon bisulphide; ammonium hydrate; carbolic acid; sodium sulphate. bicarbonate and carbonate; potassium bichromate; mercuric chloride, and salicylic acid.

Fifty untreated strips, alternating with the treated ones and containing a total of 6,227 square feet, afford the basis for comparisons. The total heads produced on these 50 plats were by actual count 122,432, of which over seventy-one per cent. were smutted. The highest per cent. of smutted heads on any plat was 81.61 per cent.; the lowest was 53.54 per cent. The average number of bushels of sound grain per acre (calculated) on 41 of these plats is only 4.68. By an oversight no calculation was made for the other nine plats, but these were much like the rest, and the average of the fifty could not have varied much from that here given.

Undoubtedly the yield was smaller and the per cent of smut greater owing to the fact that the grain was sowed in November and made a slow and feeble autumn growth. In this connection it is interest-

ing to note that the per cent of smut was greatest on the latest sowings as the experiments of Brefeld would lead us to expect. The wheat was soaked in the fungicides or subjected to their vapors in case of chloroform, etc.

The experiments which proved most successful were as follows:

No. 13. Hot water 131–132° F., 15 minutes. Smutted grains skimmed off.
No. 15. Hot water 132–151° F., 15 minutes. Smutted grains not skimmed off.
No. 21. Copper sulphate, 8 per cent., 24 hours; not limed.
No. 23. Copper sulphate, 8 per cent., 24 hours; limed.
No. 25. Copper sulphate, 5 per cent., 24 hours; not limed.
No. 27. Bordeaux mixture, 36 hours.
No. 29. Bordeaux mixture, half strength, 36 hours.
No. 45. Arsenic, saturated aqueous solution, 24 hours.
No. 57. Copper sulphate, ½ per cent. solution, 24 hours.
No. 87. Potassium bichromate, 5 per cent. solution, 20 hours.

The following table shows at a glance what has been accomplished:

Plot.	Heads smutted.	Bushels of sound grain (calculated.)
	Per cent.	*Per acre.*
Average of the untreated	71.29	4.68
No. 13	0.13	14.37
No. 15	0.82	15.36
No. 21	0.36	.....
No. 23	0.31	12.52
No. 25	0.00	13.54
No. 27	0.00	.....
No. 29	0.06	.....
No. 45	1.09	13.75
No 57	0.74	.....
No. 87	0.00	17.01

The authors recommend the Jensen or hot-water method as the best on the whole. This treatment did not destroy quite all the smut, but it killed none of the wheat grains, and gave the largest yield except No. 87, which was only a small plot. Full directions are given for making this treatment.

The bulletin shows evidence of unusual care in preparation and a visit to the station during the progress of the experiment led me to believe that particular attention was given to all the details of the experiment, which is one involving a very great amount of painstaking labor.

The graphic illustrations deserve special commendation.—ERWIN F. SMITH.

NEW SPECIES OF UREDINEÆ AND USTILAGINEÆ.

By J. B. ELLIS and B. M. EVERHART.

SCHROETERIA ANNULATA, n. s. In ovaries of *Andropogon annulatus* from India (Herb. of S. M. Tracy). Mass of spores brownish black, pulverulent. Spores in twos or occasionally in threes, flattened on the line of contact, hyaline and 12–15μ diameter at first, becoming brown and separating into two distinct spores 7–10μ diameter. Epispore smooth or nearly so.

SCHIZONELLA SUBTRIFIDA, n. s. N. A. F. 2266. In flowering heads of *Cirsium ochrocentrum*. Wet Mountain Valley, Colo., July 25, 1888. Rev. C. H. Demetrio. No. 162. Spores violet or purple brown, subglobose or elliptical, soon becoming uniseptate and finally separating into two hemispherical segments. Epispore strongly tubercular-roughened, 12–20 by 12–16μ. Occasionally spores are seen with a triradiate septum much the same as in the spores of *Triphragmium clavellosum*, Berk., and in this case the spore separates into three parts instead of two, but the great majority of the spores are bifid. The fungus occupies the whole interior of the flowering heads, which become hollow and abortive.

USTILAGO DIPLOSPORA, n. s. In ovaries of *Panicum sanguinale*, Holly Springs, Miss., September 1890. Tracy No. 1551. Mass of spores dark brown. Spores of two kinds, the smaller ones globose, rough, brown, 7–8μ diameter, the larger ones 12–15μ smooth, globose, pale, nearly hyaline.

USTILAGO MONTANIENSIS, n. s. On *Muhlenbergia glomerata*, Sand Coulee, Mont., December 1887. Leg. Anderson. In the inflorescence which is rendered abortive and remains inclosed in the sheaths of the leaves. Mass of spores dark brown, nearly black. Spores subglobose, 10–14μ diameter or oblong or ovate oblong, 12–16 by 10–12μ epispore subtuberculose-reticulated, pale-brown.

ÆCIDIUM MICROPUNCTUM, n. s. On *Castilleia* from Pine Ridge, Nebr., July, 1890. Prof. T. A. Williams. Æcidia gregarious in oblong groups or patches 3–5^{mm} long and 2–3^{mm} wide, small ($\frac{1}{4}^{mm}$), sunk in the substance of the leaf, which is only slightly thickened, border narrow, erect, sublacerate. Spores subglobose or suboblong, more or less angular, smooth, 18–20μ in the longer diameter, orange yellow, approaching orange red.

ÆCIDIUM EUROTLE, n. s. On *Eurotia lanata*, Helena, Mont., Rev. F. D. Kelsey, June 1889, Com. F. W. Anderson. No. 514. *Æcidia hypophyllous*, arranged along each side of the midrib, short cylindrical, about $\frac{3}{4}^{mm}$ high and $\frac{1}{2}^{mm}$ broad, with a thin, suberect, sublacerated margin. Spores orange-yellow, subglobose, smooth, 15–20μ diameter.

UROMYCES SCABER, n. s. III. On leaves of some grass. Swift Creek, Custer County, Colo., October 1888. Cockerell, No. 62. Sori elliptical, bare, dark chestnut color, nearly black, $\frac{1}{2}$–1^{mm} long by $\frac{1}{4}$–$\frac{3}{4}^{mm}$ wide, pulvinate, gregarious or subconfluent. Spores globose 20–22μ or elliptical 22–25 by 20–22μ, densely echinate-scabrous, epispore scarcely thickened at the apex, pedicels subequal, hyaline, 40–50 by 4.

PUCCINIA ARABICOLA., n. s. On *Arabis* sp. Ottawa, Canada. Dr. J. Macoun, I and III.

I. Æcidia amphigenous, collected in patches or groups 2–4^{mm} across, hemispheric and closed at first, then open, small, shallow, margin slightly spreading and minutely denticulate. The spores having mostly disappeared from the rather scanty specimens, we can not now accurately describe them.

III. Sori amphigenous, scattered, small, black-brown, covered at first

by the lead-colored cuticle which is at length ruptured and forms a border around the margin. Spores elliptical, oblong or obovate, rounded and thickened above, smooth, constricted at the septum, 27–40 by 20–23μ on rather stout pedicels about as long as the spores. This is quite distinct from *P. thlaspeos*, Schubert, which has the sori paler and hypophyllous and has no æcidium. *P. aberrans* (N. A. F. 1834) is also different from this.

PUCCINIA ARALIÆ, n. s. On ginseng (*Panax trifolium*), Massachusetts, May, 1888, Miss C. H. Clark and M. C. Carter, III. Parts attacked more or less distorted. Sori caulicolous and foliicolous, minute, clustered in tufts 1–2^{mm} across, naked and of a dark-brown or nearly black color, not on any definite spots though the affected leaves turn more or less distinctly light yellow, the yellow area occupying a large part of the leaf. On some of the leaves the sori were placed opposite on each side of the leaf, but in this case those on the upper surface were smaller. Spores oblong or oblong-elliptical, with fine, granular contents, and granular-roughened, pale-brown epispore scarcely thickened at the apex, which is either regularly rounded and obtuse or capped with a small hyaline papilla. Scarcely constricted, 25–35 by 15–20μ on rather slender pedicels, about as long as or a little longer than the spore itself.

PUCCINIA XANTHIIFOLIA, n. s. (*P. compositarum*, Schlect. in N. A. F. 2252.) On leaves of *Iva xanthiifolia*, Manhattan, Kans., October, 1888. Dr. W. A. Kellerman. I and II not seen. III. Sori hypophyllous scattered, bare, black, $\frac{1}{2}$–1^{mm} diameter, tuberculiform, compact. Teleutospores, elliptical or obovate-elliptical, smooth, rounded and thickened at the apex and mostly with a distinct papilla, constricted at the septum, deeply colored 35–45 by 18–23μ on long (70–80μ), slender, subpersistent pedicels. This is a very different thing from *P. compositarum*, for which, by some inexplicable error, it was distributed in N. A. F. *P. intermixta*, Pk., according to authentic specimens, is also very distinct from this.*

PUCCINIA CONSIMILIS, n. s. On leaves of *Sisymbrium linifolium*. Helena, Mont., May, 1889. Rev. F. D. Kelsey, No. 53. I and III. Hypophyllous. Acidia covering the greater part of the lower surface of the leaf. Shallow, soon open, margin sublacerate-toothed and narrowly reflexed. Æcidiospores pale yellow, subglobose or subovate, smooth, 20–23μ diameter.

III. Sori minute, $\frac{1}{2}^{mm}$ diameter, crowded but not confluent and like the æcidia occupying the greater part of the lower surface of the leaf, chestnut brown, closely surrounded by the ruptured epidermis, but naked above almost from the first. Teleutospores oblong-obovate, constricted, 25–42 by 18–22μ, thickened at the apex, with or without a papilla, which when present is either central or oblique, upper cell mostly broader and darker, lower cell also generally rounded at the base, pedicels as long as or longer than the spores.

* *Puccinia bigelovii*, E. and E., N. A. F. 2248, is on *Gutierrezia euthamiæ*, and may be only a form of *P. tanaceti*.

I and III occur together on the same leaf. The spermogonia were not observed. Possiby the *Æcidium* may be *Æcid. monoicum*, Pk., but the color of the spores is different and the cups are open almost from the first. The manner of growth is the same.

NOTES ON CERTAIN UREDINEÆ AND USTILAGINEÆ.

By F. W. Anderson.

ÆCIDIUM CRASSUM, Pers., *Æcidium rhamni*, Pers., and *Æcidium pulcherrimum*, Ravenel, are identical, and are considered to be I of *Puccinia coronata*, Corda. In Sacc. Sylloge *Æcidium pulcherrimum* is retained, probably inadvertently, in specific rank, although it plainly belongs as above. No. 933 of de Thümen's Mycotheca Universalis, given as *Æcidium rhamni*, Persoon, is identical with Ravenel's specimen of *Æcidium pulcherrimum*.

NUMBER 1003 of Ellis's N. A. F. is *Æcidium ranunculacearum*, DC. But *b* of this number is *Æcidium ranunculi*, of Schweinitz. The most available, and as it appears to me fairly constant, points of distinction between these two species are as follows: *Æcidium ranunculacearum*: æcidia always in spots, preceded or accompanied by the spermogonia which are aggregated usually in the center of the æcidium spots. *Æcidium ranunculi*, Schweinitz: æcidia always effused, preceded or accompanied by the spermogonia, which are also effused and scattered, like the æcidia, indiscriminately over the surface of the leaf. Sometimes the leaf is thickly covered by the fungus and again it may bear only a cup here and there. The form of *Æcidium ranunculacearum* on *Ranunculus Cymbalaria*, so common at the West, at times shows some inclination to approach *Æcidium ranunculi* in its manner of growth, but after all never seems to lose entirely its specific characters.

ÆCIDIUM ALBUM, Clinton, in 26th Report of the New York State Museum for 1874 and *Æcidium porosum*, Peck, in Botanical Gazette, page 34, 1878, are identical. The two supposed species occur on the same host plants, and have constantly the same manner of growth from New York State to the Pacific Ocean. Herewith is given an amended description of this species: Spots none, cups few and scattered and almost superficial, or much crowded, in which case they appear to be deep-seated and give a porous appearance to the leaf surface; occupying a part or the whole of the lower surface of the leaves; frequently appearing on the stems also, in which situation they are hemispherical, or short-cylindrical, erumpent, and opening by a small, irregular, or roundish orifice. Spores from a bright orange color to almost colorless, very variable in this respect, subangular or roundish, oblong, oval or ovate, according to the free or crowded condition of the cups. 18 μ to 26 μ diameter. Saccardo in Sylloge, vol. 4, p. 787, says that *P. porosum* is distinct from *P. album*, but this can not be so.

ÆCIDIUM HELIOTROPI, Tracy and Galloway, is the same as *Æcidium biforme*, Peck, which was published first and therefore has precedence.

ÆCIDIUM PALMERI, n. s.

On *Pentstemon virgatus*. Willow Spring, Ariz., June, 1890, collected by Dr. Edward Palmer. Com. Dr. J. N. Rose.

Spots more or less elongated, but little paler than rest of leaf; a little or not at all thickened. Pseudoperidia not deep seated, amphigenous; usually numerous and closely set, but not crowded together; when first bursting the epidermis, ovate and nearly white, or with the faintest possible purple tinge; soon becoming cylindric-clavate, with rounded or ovate apex; twice to at least four times as high as broad, straight or slightly curved; becoming flesh-colored fading to white above and at last becoming reddish-orange and sometimes opening by a small central orifice in the rounded apex, but more frequently opening by the fragile, white, broadly and irregularly ovate, to deeply cleft, acute, erect marginal lobes, which latterly fall away, often irregularly, exposing to view the orange-colored spores which fill the tubes. Spores roundish or irregularly polygonal to ovate or oblong and variously compressed; smooth, or very minutely roughened, epispore thickish; spore contents granular, with numerous yellow oil globules which escape freely under pressure; usually there are also two or three deep yellow and variously shaped nuclei. Spores orange colored, $16-26\times16-23$ μ.

This well marked Æcidium is very distinct from *Æcidium pentstemonis*, Schwein.

PUCCINIA CLADOPHILA, Peck, on *Stephanomeria minor*, in Botanical Gazette February, 1879, page 127, is the same as *Puccinia Harknessii*, Vize, on *Lygodesmia*, in Grevillia, vol. 7, page 11, September, 1878. The latter has been referred to *Puccinia hieracii*, (Schum.) Mart., (P. Dietel in Hedwigia, 1889, page 181); therefore *Puccinia cladophila* must also be referred to *Puccinia hieracii*, as that species is now understood.

PUCCINIA MINUSSENSIS, de Thümen, No. 1430 of de Thümen's Mycotheca Universalis, is, like the preceding, *Puccinia hieracii*, (Schum.) Mart., and is very near the form on *Troximon glaucum* and the same as the form on *Lactuca pulchella* (syn. *Mulgedium pulchellum*), which is an American species nearly related to *Mulgedium Siberica*—the host of de Thümen's present species.

In Saccardo Sylloge, vol. 7, this *Puccinia* is left in specific rank, but the note after the description refers to its connection with *P. hieracii*.

PUCCINIA BIGELOVIÆ, Ellis and Everhart, in N. A. F., No. 2248, has accidentally been named after a wrong host genus. The specimens distributed in North American Fungi are on *Gutierrezia euthamiæ*. The genus *Gutierrezia* is related to *Bigelovia* and it is likely that the fungus will yet be found on hosts in the latter genus, for which reason the authors of the species prefer to let the specific name go unchanged.

Western mycologists would do well, however, to make a series of cultures with the spores of *Puccinia bigeloviæ*, *Puccinia variolans*, Harkness and of *Puccinia variolans*, *var. caulicola*, Ellis and Everhart, to see

whether or no these are really distinct. At the same time cultures should be made with the spores of *Puccinia tanaceti*, DC.,* to which they seem to be too closely related, to see again whether they are distinct from that species, for, after a careful study of a large and varied supply of material and the accurate sketching of spores of each form, their validity is left much in doubt. Properly conducted cultures alone can positively decide the question.

Puccinia Ellisiana, Thüm., in Bulletin of the Torrey Botanical Club, Vol. VI, p. 215, is now regarded by Mr. Ellis, Professor Farlow, and others to be the same as *Puccinia andropogonis*, Schweinitz, which has the right of priority.

Puccinia Windsoriæ, Schw., var Australis, n. var. (*Puccinia Dochmia B. and C.*, North Pacific Expl. Exped., No. 131, and *Puccinia Palmeri*, Scribner in herb.) On grass leaves, apparently *Muhlenbergia*, Nicaragua, Central America; C. Wright coll. No. 131, N. P. Expedition; also on *Muhlenbergia* sp., Mexico; collected by Dr. Ed. Palmer, 1886.

Hypogenous or sparingly amphigenous. Sori small, rather more pulvinate than in the species, owing to the long spore pedicels, irregularly disposed, linear or oblong, more or less confluent, but rarely so in straight lines, the ruptured epidermis scarcely or not at all evident. Uredospores subglobose, obovate to oblong-ovate, brown, tegument somewhat thickened; epispore more or less distinctly echinulate, 16–25 by 20–26; teleutospores obovate, broadly elliptical to subglobose, the two last forms predominating; from pale to deep chestnut brown, usually darkest at the thickened vertex; little or not at all constricted at the septum, obtusely rounded or occasionally bluntly apiculate, 16–30 by 23–36 μ; pedicel pale brown to subhyaline, 75–125 μ long, by 3 to 6 μ thick at the base of the spore. Differs from the species in the very marked preponderance of the subglobose form of teleutospores and in the very long slender pedicels. A form almost the same as this occurs in the District of Columbia and in Florida. This form again is linked to the various forms of the species as they occur in different northern States. The description of the species itself should be a little more modified in order to embrace the usual, but not the glaring variations. It is also to be noted that in the variety as well as in the species the spores are often more or less obliquely to vertiseptate and the pedicels often to all appearances come from the side instead of from the base of the teleutospore.

In Saccardo's Sylloge, Vol. VII p. 770, are given brief descriptions of *Triphragmium clavellosum*, Berk., and *Triphragmium Thwaitesii*, B. & Br. The former occurs in America on *Aralia nudicaulis*, and is said (l. c.) to occur also in Ceylon on *Paratropa terebinthinacea*, *Hedera* and *Amygdaleæ* species. The latter is given for Ceylon as occurring on *Hedera Vahlii*, and the question is asked whether it is not the same as

*A careful study should also be made of *Puccinia tanaceti* DC. var. *Actinellæ* Webber on *Actinella acaulis*. If this is a good variety, then perhaps some others now included in the species, should be regarded in the same light. Anders.

T. clavellosum. I have not been able to secure Ceylon specimens referred to *T. clavellosum*, but it is quite likely that all such are referable to *T. Thwaitesii*. Of this latter I have secured an authentic specimen from Mr. J. B. Ellis, to whom it was sent by Dr. M. C. Cooke, of London, England. As *T. clavellosum* and *T. Thwaitesii* are related species it is easy to understand why confusion should arise concerning them, especially when we consider the meager published description in which spore measurements are entirely omitted. *T. Thwaitesii* is a quite distinct species from North American forms of *T. clavellosum*, and it is pretty safe to say that *T. clavellosum* is American and that *T. Thwaitesii* is Asiatic. I have, in the following, drawn up full descriptions of the two species. For the description of *T. clavellosum* I selected No. 844 of De Thümen's Mycotheca Universalis on *Aralia nudicaulis*, collected in the Adirondack Mountains, New York, by Ch. H. Peck. For the description of *T. Thwaitesii* I used the small specimen sent me by Mr. Ellis.

TRIPHRAGMIUM CLAVELLOSUM, Berk.

Epiphyllous; sori small, roundish-orbicular, or elliptical, surrounded by the ruptured epidermis and distinct, or as often confluent into apparently one large sorus, a quarter of an inch across, growing on more or less well-defined spots. Uredospores not seen; teleutospores 30–40 μ long by 16–30 μ wide, globose to obovate or oblong in outline, the margin frequently not at all lobed, dark brown to almost black, epispore thickened and with numerous stout somewhat tapering appendages, the tips of which are emarginate, bifureate, or even quadrate with four hyaline recurved lobes; pedicel at least as long as the spore, usually longer, 40–100 by 5–10 μ thick at junction with base of spore, average size about 50 μ long by 6 μ thick, not much tapering and somewhat roughened. On *Aralia nudicaulis*.

TRIPHRAGMIUM THWAITESII, B. & Br.

Amphigenous, but most abundant on the upper surface of leaf: sori small, roundish, rarely confluent, growing on well defined irregular patches, which are blackish above and paler below. Uredospores (?) 28–35 by 30–50 μ, oval to obovate, rather dark yellowish brown, epispore thickly beset with sharp awl-shaped spines about 3 μ long: pedicel about length of spore, hyaline; teleutospores 30–60 μ long by 27–59 μ wide, globose to obovate outlined, more or less perfectly and uniformly three-lobed, often truncate at the apex, light brown to dark chestnut brown; epispore rather thick, appendages few, straight and tapering, expanding at the end into an emarginate and often distinctly bifureated tip; pedicel about the length of the spore, seldom longer, slightly roughened, tapering to the slender and usually curved point, about 5 μ thick at junction with base of the spore. It is possible that the uredospores described in the foregoing may belong to something else, as I only found two spores and they were mixed in with teleutospores. On *Hedera*, (?) Ceylon.

UROMYCES AMYGDALI, credited to Cooke in report on Insect and Fungous Pests, No. 1, by Henry Tryon, issued by the Department of Agriculture, Queensland, Australia, is doubtless *Uromyces amygdali*, Passer.; see the above report, page 97, Leaf Rust and Shedding of Foliage (*Uromyces amygdali*). At any rate this "*Uromyces*" turns out to be the uredo of *Puccinia pruni*, Pers. (See also Sacc. Syll. vol. VII, p. 648.) A series of excellent specimens has been received by the Division of Vegetable Pathology from two points in South Australia, collected on peach, plum, apricot, and almond leaves by Mr. F. S. Crawford and Mr. R. H. Simons. In some of these specimens the teleutospores have developed, and are present in great numbers in the same sori with the uredospores. They agree in every particular with specimens of *Puccinia pruni*, Pers. on peach and plum hosts in the United States.

UROMYCES SOPHORÆ, Peck, in Bulletin Torrey Bot. Club, Vol. XII, No. 4, p. 35, and *Uromyces hyalinus*, Peck, in Bot. Gaz. 1878, p. 34, are identical, and both again referable to the widely dispersed and consequently somewhat variable *Uromyces trifolii*, (Hedew.) Léveillé.

ENTYLOMA CRASTOPHILUM, Sacc., and ENTYLOMA IRREGULARIS, Johanson, are the same species, judging from the two specimens in the Herbarium of the Division of Vegetable Pathology—Krieger, Fungi Saxonici, 202; *Entyloma crastophilum*, Sacc. (Michelia I, p. 540, September 15, 1879), on *Agrostis?* W. Krieger leg; and Eriksson, Fungi Parasitici Scandinavici 259; *Entyloma irregularis*, Johanson, on *Poa annua*, C. J. Johanson coll. In the former specimen the spores are more angular than in the latter; the color is almost the same and the measurements of both are the same. As I make them, the measurements are 6–10 by 8–20μ, but rarely over 16μ long.

Saccardo's description was published first, hence *Entyloma crastophilum*, Sacc, has precedence.

USTILAGO SUCCISÆ, Magnus, *U. scabiosæ*, (Somer.) Wint. and *U. intermedia*, Schroeter, as given in Saccardo's Sylloge, vol. VII, p. 475 and 476, appear to be one species. They all occur in the anthers of *Scabiosa columbariæ* and *Scabiosa arvensis:* the name, *Knautia arvensis*, given in the Sylloge, is simply the old name of *Scabiosa arvensis. Ustilago intermedia* only differs from the other forms in its darker and more evidently reticulated spores, and does not seem to be more than a variety of *U. scabiosæ*, to which the other forms should be referred, and it is doubtful whether it deserves even varietal rank.

The notes now following were made directly from Berkeley & Curtis's type specimens in the Herbarium of the U. S. North Pacific Exploring Expedition under Commanders Ringgold and Rogers, 1853–'56. C. Wright collected the specimens.

PUCCINIA KAMTSCHATKÆ, Anders., n. s. On *Rosa* species, collected by C. Wright at Petropaulovski, Kamtschatka. Description

drawn up from specimen in the herbarium of the United States North Pacific Exploring Expedition under Commanders Ringgold and Rogers, 1853–'56. Specimens labeled "*Coleosporium pingue*, Lév. ?"

Amphigenous, but most abundant on lower surface of leaf where the sori are confluent and irregularly effused; on the upper surface the sori are usually small, fewer, and less often confluent; surrounded more or less perfectly by the much lacerated and conspicuous epidermis: in the effused patches irregular lines of this epidermis stick up here and there, marking more or less plainly the boundary of several or many irregularly confluent sori. Sori rather large, variable in outline, not definitely arranged, becoming pulverulent; light snuff-colored. Uredospores globose, short ovate, obovate to oblong elliptical, smooth or slightly roughened, pale yellowish brown to light brown; epispore one-half to almost 3μ thick, but little or not at all thickened at the vertex, 13–27 by 13–30μ. Teleutospores oblong, ovate, oval to broadly elliptical, segments generally divided equally, usually not much constricted at the septum; vertex broadly rounded or occasionally narrowed, but not apiculate; epispore as thick as that of the uredospores, smooth or somewhat roughened, frequently a little thickened at the vertex, light brown, 13–37 by 20–54μ; pedicel stout, but fugaceous, yellowish hyaline, once to twice the length of the spore; paraphyses intermixed with the spores, pedicel-like, cylindrical, a little or not at all swollen at the rounded apex.

The general appearance of this Puccinia *en masse* is that of the uredo stage of *Phragmidium subcorticum*, (Schrank). It thickens and changes the shape of the leaf just as that does, and without a microscopic examination would be passed over as *Phragmidium subcorticum II*, turned snuff brown. *Coleosporium pingue*, Léveillé, is merely the uredo of *Phragmidium subcorticum*. It is more than likely that *Puccinia Kamtschatkæ* will be found by careful seekers on various *Rosa* forms in the northern Rocky Mountains and along the northwestern coast of America.

Puccinia triarticulata, B. & C. Herbarium of the North Pacific Exploring Expedition, No. 130. Collected by C. Wright on *Elymus mollis*, Arakamtchetchene Island, Behring Straits. The original description is not complete, lacking spore measurements and other notes of value. We may expect to find this species in Alaska and along the northwestern coast of America generally. The following more complete description has been drawn up from a type specimen: Sori linear to narrowly oblong, buried in the tissue, but forming a pustule on the surface of the host, finally bursting the epidermis and presenting a level dark-brown surface. Uredospores? Teleutospores two to three septate, 60–100 by 12–24μ; pale brown, elongated, oblong, narrowly cuneate or cylindric-clavate, with an ovate, or rounded, or more or less obliquely truncate apex, constricted at the septa or not; epispore thin, smooth, vertex frequently thickened; pedicel short, stout rather dark reddish brown,

strongly contrasting with the pale color of the spore, 5–9 by 5–14μ, and rather firmly attached to the dense parenchymatous stroma, which, like the pedicel, is reddish brown. This peculiar species is rather a doubtful Puccinia.

PUCCINIA SEPULTA, B. & C. Herbarium North Pacific Expedition, No. 131, on leaves of *Ficus?* Nicaragua, Central America. C. Wright, collector.

Hypophyllous, spots orbicular, brown on both sides, but more definitely outlined on the upper; bullate above, concave beneath; sori congested in a uniform mass and more or less perfectly covered by the host hairs adherent to the epidermal fragments protruding from between the crowded sori. Uredospores? Teleutospores 23–75 by 13–27, brown and smooth, extremely variable in size and shape, narrowly oblong and much elongated, or broadly clavate, obtusely elliptical, obovate, cuneate to broadly subturbinate; constricted at the septum, or not; apex subtruncate, or variously rounded, sometimes narrowed, usually thickened, lower segment quite often narrow and distinguishable only from the broad and often somewhat swollen pedicel by the septum at base, where it is often constricted; pedicel narrow or broad, frequently swollen above, but constricted at junction with the spore, less than twice the length of the spore, brown, or dilute brown, often coming from one corner of spore base instead of the center. Occasionally three-celled spores are seen, and even two perfectly formed spores normal in size are found, the base of the upper joined closely to the apex of the lower by about the width usually occupied by the pedicel; or, two spores may be joined laterally by a small surface of the upper segments, the lateral spore having no pedicel of its own, and again, the upper segment also of an individual spore is sometimes vertically septate, showing an inclination towards *Triphragmium.*

UREDO BAUHINIÆ, B. & C. Fungi North Pacific Expedition, No 138. C. Wright, coll., on *Bauhinia* sp.

Amphigenous, but more sparing above. Spots small, yellowish, or quite obsolete. Sori small, roundish, or orbicular, scattered, rarely confluent, dark reddish brown, the ruptured epidermis more or less evident; spores globose, broadly obovate or broadly and obtusely elliptical, echinulate, reddish fuscous, 26–30 by 26–33μ, epispore 3–5μ thick; pedicel 20–30μ long, hyaline and fragile.

INDEX TO NORTH AMERICAN MYCOLOGICAL LITERATURE.

By David G. Fairchild.

113. Arthur, J. C. **Treatment for smut in wheat.** Bull. 32, Vol. II, July, 1890, pp. 1–10, Indiana Agr. Exp. Sta., La Fayette, Ind. Gives tests of vitality of seed wheat after treatment with Jensen hot-water method for smut. Finds 66° C. as maximum temperature at which the vitality of the seeds is retained and immersion for five minutes in water at a temperature of 57° C. to give the largest percentage of uninjured grains, considering high temperature. Recommends lengthening time of immersion with lowering of temperature and vice versa. No test of the method as to preventive power against smut. Gives percentages of stalks smutted with loose smut in counts of two varieties as 11.58 per cent. and 24.41 per cent.

114. ——— and Bolley, H. L. **The specific germ of the carnation disease.** Bot. Gaz., September, 1890, Vol. XV, No. 9, p. 231 Abstract of paper read by title before A. A. A. S. Botanical Section, August 19, 1890. Indicates demonstration of bacterial disease.

115. Atkinson, Geo. F. **A new Ramularia on cotton** (with figures). Bot. Gaz., Vol. XV., No. 7, July 22, 1890, p. 166. Describes and figures as new, *Ramularia areola*, n. s. on cotton, which differs from *R. serotina* and *R. virgaureæ* in having stouter conidia and hyphæ.

116. Bailey, L. H. **Report on the condition of fruit-growing in western New York.** Bull XIX, August, 1890, Cornell Agr. Exp. Sta., Ithaca, N. Y., pp. 45–58 (with figs) Notices as particularly abundant in 1890: *Fusicladium dendriticum*, (Wallr.) Fckl. on apples; *F. pyrinum*, (Lib.) Fckl. on pears. Quince and pear leaf blight, *Entomosporium maculatum*, Lév. *Taphrina deformans*, *Glœosporium venetum* or *G. necator*, *Sphærella fragariæ*, Sacc. and various grape diseases. Gives latest ideas in treatment of various maladies.

117. Beadle, D. W. **The apple scab.** Horticultural Art Journal, Rochester, N. Y. October, 1890, Vol. V, part 10, p. 82. Sums up work of L. R. Taft in Mich., Agr. Exp. Sta. in 1889 (*see* 104).

118. Bessey, Chas. E. **The completion of Saccardo's Sylloge Fungorum.** American Naturalist, July, 1890, XXIV, 283, p. 675. Reviews and commends the work, giving synopsis of orders with total numbers of species described, 31,927 in all.

119. Bolley, H. L. **Potato scab, a bacterial disease.** Bot. Gaz., September, 1890, Vol. XV, No. 9, p. 234. Abstract of paper read before A. A. A. S. Botanical Club, August 19, 1890. Gives histology and biology of disease, with outline of infection experiments performed.

120. ———. **Potato scab, a bacterial disease.** Agricultural Science, La Fayette, Ind., September 1890. Vol. IV, No. 9, pp. 243–256. Discusses at some length the theories regarding the nature and cause of the disease, viz., mechanical irritation, insect agencies, chemical erosion, excess of moisture, action of fungi. Follows with a record of original investigation, noting work of Dr. Brunchorst, of Sweden, who describes *Spongospora solani* as cause of the malady. Records results of various infection tests, inoculating young tubers in various ways with various species of bacteria found present in the diseased areas. Gives conclusive experiments to determine that disease is transmitted by the practice of planting scabby seed potatoes.

121. ——— *Ibid.* Oct. No. 10. pp. 277–287. Continues description by treating of separation and culture methods; infection or inoculation of growing tubers; characteristics of development upon artificial culture media: drop cultures; stick cultures; streak cultures; cultures on sliced cooked potatoes; effect of

121. Bolley, H. L.—Continued.
gases and of different degrees of temperature upon the development of the bacterium; name of bacterium, relation to the host, mode of attack. Gives plates III and IV with bibliography of disease.

122. Britton, N. L., and Hollick, Arthur. **List of Staten Island fungi in the collection of the Association.** Proc. Nat. Sci. Ass. of Staten Island. Special, No. 11, August 1890. *Basidiomycetes* 37. *Ascomycetes* 3, *Hypomycetes* 1. *Myxomycetes* 1. Determinations by J. B. Ellis.

123. Chester, F. D. **Diseases of the vine.** Bull. X, Delaware State Agricultural Exp. Sta., Newark, Del. 1890, pp. 8–32. Gives results of experiments at Smyrna with black-rot. Used Bordeaux mixture and saved 99.5 per cent. fruit in comparison with 84 per cent. unsprayed. Records use of ammoniated copper carbonate, copper carbonate and ammonium carbonate mixture, precipitated copper carbonate, and Bordeaux mixture against anthracnose, deciding the precipitated copper carbonate and Bordeaux mixtures as wholly effectual. Reports use of above copper mixtures with modified eau celeste and mixture No. 5, U. S. Dept. of Agr. against black-rot near Newark, also of study, by periodical bagging, of progress of disease in vineyards. Gives directions for preparing fungicides, prices of chemicals, and recommendations as to spraying apparatus.

124. Ellis, J. B., and Everhart, B. M. **New North American Fungi.** Reprint from proceedings of Academy of Natural Sciences of Philadelphia, July 29, 1890. Describes as new 100 species, mostly saprophytic, as follows: *Typhula subfasciculata, Stereum atrorubrum, Hymenochæte rugispora, Asterina rubicola, A. bignoniæ, Chætomium pusillum, Myriococcum consimile, Calosphæria alnicola, C. macrosperma, Calosphæria corticata, Diaporthe nivosa*, Ell. & Holw., *Valsa floriformis, V. glandulosa*, Cke., *V. (Eutypella) canadisca*, Ell. & Holw., *Pseudovalsa stylospora, Thyridaria fraxini, Cryptovalsa sparsa, Diatrype Maconnii, D. Hochelagæ, Diatrypella vitis, D. Demetrionis, Ceratostomella mali, Ceratostoma juniperinum, C. parasiticum, C. conicum, Rosellinia albolanata, R. glandiformis, R. parasitica, R. Kellermanni, R. Langloisii, Anthostoma Ontariensis, Anthostomella ludoviciana*, Ell. & Lang., *Hypoxylon albocinctum, Poronia leporina, Physalospora zeicola, P. conica, P. pandani, Lasiadia orientalis, L. apocyni, Sphærella conigena**, *S. spinicola, S. ciliata, S. angelicæ, S. maculæ, S. polifolia, Didymella Canadensis, D. cornuta, D. andropogonis, D. mali, Venturia parasitica, V. sabalicola, Diaporthe Columbiensis, D. (Euporthe) leucosarca, D. corinigera, D. comptoniæ, D. Americana*, Speg., *D. megalospora, Didymosphæria andropogonis*, E. & Lang., *Melanconis salicina, Valsaria salicina, Leptosphæria maculæ, L. steironematis, L. brunellæ, L. folliculata, Metasphæria rubida, Pleospora diaporthoides, P. hyalospora, Pyrenophora Zabriskieana, Fenestella amorpha, Ophiobolus trichisporus, O. medusæ, Melanomma Commonsii, M. tetonensis, M. parasiticum, Winteria tuberculifera, Cucurbitaria Kelseyi, C. fraxini, C. setosa, Teichospora mammoides, T. mycogena, T. umbonata, T. papillosa, T. megastega, T. Helenæ, T. Kansensis, Nectria diplocarpa, Hypocrea pallida, H. melaleuca, Calonectria Dearnessii, Thyronectria chrysogramma, Chilonectria crinigera, Nectria sambuci, N. athroa, N. mammoidea*, Phil. & Plow., *N. pithoides, N. sulphurata, Homostegia Kelseyi, Dothidea bigeloviæ, Plowrightia staphylina, P. symphoricarpi, Curreya shepherdiæ.*

125. Fairman, C. E. **Contributions to the mycology of western New York.** I. The fungi of western New York. Extract, Proc. Rochester Academy of Sciences, Vol. I, August, 1890, pp. 43–53, with plates 3 and 4. Notes the discovery in Orleans County of 425 species variously distributed among the different orders, with remarks on more common species. Remarks: *Septoria stellariæ*, R. & D., on

* This is changed to *S. Andersoni*, as there is already an *S. conigena*, Pk.

125. FAIRMAN, C. E.—Continued.

Stellaria media. *Phyllosticta cirsii*. Desm., on *Cnicus arvensis*. *Corticium lividocæruleum*. Karst., *Tapesia rosa* (Pers.) as new to this country. Appends list of 30 species or varieties, 17 of which are new. Those described as new are as follows: *Didymosphæria accedens*, Sacc. (with fig.) *Anthostomella eructans*, E. & E. (with fig.) *Lophiostoma rhopaloides*, Sacc. var *pluriseptata*, n. var., *Pseudovalsa Fairmani*, E. & E., *Vermicularia solanoica* n. s. on *Solanum dulcamara*, *Phoma Weldiana* n. s. on *Euonymus atropurpureus*, *Phoma albovestita*, n. s., *Phoma Lyndonvillensis*, n. s. on *Malva rotundifolia*, (with fig.) *Phoma rudbeckiæ*, n. s. on *Rudbeckia laciniata*, *Diplodia maura*, C. & E., var. *Americana*, Ell. on *Gyrus americana*, *Morthiera Thuemenii*, Cooke, var. *Sphærocysta* Pk. on *Crataegus*, *Sphæropsis lappæ*, E. & E. on *Lappa major*, *Sporidesmium toruloides*, E. & E. on *Cornus*, *Mucor tenuis*, n. s. on *Tænia solium* (with fig.) *Helotium fumosum*, E. & E. on *Leonurus cardiaca* and *Lappa major*, *Camarosporium acerinum*, E. & E. on *Acer* limbs, *Tubulina cylindrica*, Bull., var. *acuta*, Peck.

126. FARLOW, W. G., AND SEYMOUR, A. B. **A provisional host index of the fungi of the United States, Part II.** Gamopetalæ-Apetalæ, Cambridge, Mass., September, 1890: pp. 53-133-Quarto. Part I, issued in 1888. Gives in most convenient form index of all published host plants, together with partial synonymy of different species of fungi. Myxomycetes are omitted from the list except when of more than usual interest. In cases of very common fungi occurring on many species of host plants the authors do not include all hosts, unless the fungus is of economic importance.

127. FORSTER, EDWARD J. **The Study of mushrooms.** Boston Medical and Surgical Journal, October 2, 1890. Reprinted leaflet. Gives, in reply to inquiries, a list of 14 works upon *Hymenomycetes* with special reference to esculent species. No reference made to periodical literature.

128. ———. **Mushrooms and mushroom poisoning.** Read at Ann. Meeting Mass. Med. Soc., June 11, 1890, Boston City Hospital. Pamphlet. Distinguishes, precisely, edible and poisonous forms (with figures), giving minute instructions as to habitats: adds a table of statistics of 44 cases of mushroom poisoning; concludes all known fatal cases caused by eating *Amanitæ;* gives as universal antidote atropia in full doses, ½ of a grain, preceded by usual emetics and purgatives.

129. GALLOWAY, B. T. **New fields, the past and the future in the world of fungi.** American Garden, September 24, 1890: pp. 573-577. Times Building, New York. Gives in popular language a short history of Economic Mycology, with account of the extension in this country of the use of fungicides and fungicidal apparatus. Figures examples of treated and untreated plants, together with a new knapsack pump.

130. ———. **Some recent observations on black-rot of the grape.** Botanical Gazette, October 28, 1890, Vol. XV, No. 10, pp. 255-259. Records series of four experiments to establish connection of *Phyllosticta labruscæ*, Thüm., *P. ampelopsidis*, E. & M., and *Læstadia Bidwellii*, (Ell.) V. & R. States results of 200 inoculations of grape berries with leaf pycnidiospores and 200 inoculations of leaves with berry pycnidiospores as purely negative. Fifty inoculations of berries with berry pycnidiospores also produced no result: but both inoculations of *Ampelopsis* and *Vitis* leaves with ascospores from berries produced characteristic spots and pycnidia. Gives account of methods employed.

131. ———. **Preliminary notes on a new and destructive oat disease.** Botanical Gazette, September, 1890, Vol. XV, No. 9, p. 228. Abstract of paper read before Botanical Section A. A. A. S., August 19, 1890. Notes discovery of cause of the disease as a micro-organism, grown in various cultures.

132. ———. **Observations on the life-history of Uncinula spiralis.** *Ibid.* Abstract of paper given before Botanical Section A. A. A. S. Gives life-history and methods used to establish relationship between various forms.

133. Golden, Katherine E. **Fermentation of bread.** Botanical Gazette, August 25, 1890, Vol. XV, No. 8, p. 204. Gives summary of previous work on the subject, with original investigation with plate culture methods. Finds in case examined *Saccharomyces cerevisiæ* and *Bacillus subtilis* (?) present in yeast, proving both to be able to raise bread sponges. Concludes yeast to be more effective in the production of gas in the sponges and Bacteria in the fluid cultures. Decides both to work together in producing the bread fermentation.

134. Halsted, B. D. **Peronospora rubi, Rabenh., in America.** Botanical Gazette, Vol. XV, No. 7, July 22, 1890, p. 179. Notices first appearance of the fungus on cultivated raspberry in this country.

135. ———. **Some fungous diseases of the spinach.** Bull. 70, July 26, 1890. New Jersey Agr'l College Expt, Sta., New Brunswick, N. J., pp. 15 (with 21 figs.). Gives popularized descriptions with figures of *Peronospora effusa*, Rabenh., *Colletotrichium spinaceæ*, Ell. & Hals., *Phyllosticta chenopodii*, Sacc., *Entyloma Ellisii*, Hals., *Cladosporium macrocarpum*, Drew. Points out difficulty of treatment for diseases on account of nature of use to which spinach is put and recommends clean culture, destruction of weed host plants, and cautious use of chemical fungicides, also mixture of lime and sulphur with soil.

136. ———. **A dangerous enemy to the radish.** Garden and Forest, November 5, 1890, Vol. III, No. 141, p. 541. New York City. Notes great injury to crop by a species of *Plasmodiophora*, thought to be identical or nearly related to that causing club-root of cabbage.

137. ———. **The rot among late potatoes.** Garden and Forest, November 12, 1890. No. 142, Vol. III, p. 551. Shows danger from *P. infestans* in late planting of potato

138. ———. **Effect of forest management on orchards.** Garden and Forest, October 8, 1890, Vol. III, No. 137, p. 487. Discusses injurious proximity of cedar trees bearing the fungus *Gymnosporangium*, citing marked case of injury. Notes black-knot of plum and blackberry rust in connection.

139. ———. **The egg-plant blight.** Garden and Forest, September 17, 1890, Vol. III, No. 134, p. 457. Notes destructive occurrence of *Phyllosticta hortorum*, Speg. upon leaves and fruit of egg-plant. Remarks its especially destructive nature in Gloucester County, N. J. Thinks it can be checked by the copper mixtures.

140. ———. **The celery blight.** Garden and Forest, October 1, 1890, Vol. III, No. 136, p. 141. Notes destructive abundance of *Cercospora apii* in Mercer County, N. J., its habit of thriving in dry weather; suggests use of ammoniacal copper carbonate and shading with lath as remedies.

141. ———. **Cedar galls and rust on apple leaves.** Cult. and Country Gentleman, Albany, N. Y., October 2, 1890, Vol. LV, No. 1966, p. 780. Notes destructive abundance of apple rust (*Ræstelia*) in orchards in Mercer County, N. J. Explained by proximity of cedar trees affected by cedar galls (*Gymnosporangium*).

142. ———. **Sweet potato rot in New Jersey.** The soil rot. Cult. and Country Gentleman, October 9, 1890, p. 796, Vol. LV, No. 1967. Describes the fungus as living in the soil from year to year and records cases of spread from diseased fields to healthy ones.

143. ———. **Smut in grain.** Cult. and Country Gentleman, Albany, N. Y., March 6, 1890, Vol. LV, No. 1936, p. 184. Gives description of Jensen's hot-water treatment in prevention, referring to work in Kansas by Kellerman and Swingle (see No. 156).

144. ———. **Sundry sweet potato rots.** Cult. and Country Gentleman, April 10, 1890, Vol. LV, No. 1941, p. 286. Notes five kinds of rot of sweet potatoes with suggestions as to treatment.

145. ———. **Canada thistle rusting out.** American Agriculturist, August, 1890, Vol. XLIX, No. 8, p. 402. Notes destruction of Canada thistle about New Brunswick, N. J., through the attacks of the rust (*Puccinia suaveolens*, (*Pers.*) *Wint.*).

146. HARKNESS, H. W. **Dangerous fungi.** Zoë, San Francisco, Cal., July, 1890, Vol. I, No. 5, p. 150. Gives localities in California where *Peronospora viticola*, *Plowrightia morbosa*, *Taphrina* (*Exoascus*) *pruni* are destructive. Notes freedom of *Prunus ilicifolia* from disease.

147. ———. **Fungi collected by T. S. Brandegee in Lower California.** Proc. Cal. Acad. Sci., Second Series, Vol. II, 1889, December 20, 1889 (distributed 1890). Names 14 species, describing as new, *Puccinia ornata*, Hark. with Plate XII on *Tacoma stans*, Commondu. Related to *P. medusæ*, Speg., differing in size.

148. HARVEY, F. L. **The potato rot** (*P. infestans*). Ann. Rep. Maine Ag. Exp. Sta., 1889 (1890), Bangor, Me., pp. 173, 181 (with plate by C. H. Fernald figuring so-called oospores). Gives origin, history, primary causes, secondary causes, conditions of growth, description, life-history, and remedies, direct and preventive.

149. ———. **Apple scab.** *Ibid.*, pp. 182, 184 (with plate copied from U. S. Dept. of Ag. Report, 1887). Reviews work done by Taft in Michigan and Goff in Wisconsin (see 42 and 104).

150. HICKMAN, J. F. **Smut in wheat.** Bull. Ohio Ag. Exp. Sta., Second Series, Vol. III, No. 6, July, 1890, p. 205. Reports unusual abundance of stinking smut, with table of percentages of smut estimated in field, and counts of the number of smutted grains in 1,000 grains after threshing, also result of use of too strong solution of copper sulphate.

151. HOWELL, Miss J. K. **Trimorphism in Uromyces trifolii.** Bot. Gaz., September, 1890, Vol. XV, No. 9, p. 228. Abstract of paper read before A. A. A. S. Botanical Section, August 19, 1890. Records cultures made to determine connection of the three forms. Finds æcidiospores germinating throughout the winter. Proves the relationship beyond question.

152. HUMPHREY, J. E. **Mildews.** Trans. Mass. Hort. Soc. 1889, Pt. I, 1890, Boston, Mass., pp. 40, 52. Gives statement of object of new department of vegetable physiology connected with station. Describes in clear popular language the growth, life-history, and means of combating the powdery mildews (*Peronosporaceæ*). Notes *Pythophthora infestans*, DBy., *Peronospora viticola*, B. & C., *P. gangliformis*, Tul., *P. graminicola*, Sacc. on Hungarian grass or millet, *P. Schleideniana*, Ung.

153. KEAN, A. L. **On the nature of certain plant diseases.** Bot. Gaz., Vol. XV, No. 7, July 22, 1890, p. 171. Notices peculiar habits of *Rhizopus nigricans* with reference to parasitism on sweet potatoes. Claims the discovery of an active "ferment," excreted by fungal hyphæ, which precedes the growth of the hyphæ, breaking down the tissue. Mentions alcoholic precipitate as poisonous to healthy tissue. Thinks such fungi not truly parasitic, but dependent upon chemical agents for their disease causing power. Refers to H. M. Ward's lily disease in Ann. Bot., May, 1889.

154. KELLERMAN, W. A. **Prevention of smut in cereals.** Agricultural Science, Vol. IV, No. 4, April, 1890, pp. 99-101. Lafayette, Ind., gives account of Jensen hot-water method of prevention with modification found necessary for barley, consisting in soaking the seed eight hours in cold water before plunging into hot water.

155. ———. **Prevention of stinking smut in wheat.** Industrialist, Manhattan, Kans., October 4, 1890, Vol. XVI, No. 3, p. 9. Reproduction of description of Jensen hot-water method to prevent smut contained in Bull. 12, Bot. Department, Kans., Ag. Coll. Exp. Sta., August, 1890 (see No. 157).

156. ——— AND SWINGLE, W. T. **Report on the loose smuts of cereals.** Report of Botanical Department. Extract from Annual Rep. Kans. State Ag. Exp. Sta., Manhattan, Kans., 1890, pp. 213–288, Plates I to IX. Gives most thorough treatment of the whole subject, including synonomy of loose smuts; splitting up the hitherto well-known *Ustilago segetum*, (Bull.) Ditm. or *Ustil-*

156. KELLERMAN, W. A., AND SWINGLE, W. T.—Continued

ago carbo, (DC.) Tul., indiscriminately called, into *Ustilago avenæ*, (Pers.) Jensen (oat smut); *Ustilago tritici*, (Pers.) Jensen, (loose smut of wheat); *Ustilago hordei*, (Pers.) Kellerman and Swingle (covered barley smut); *Ustilago nuda*, (Jensen) Kellerman and Swingle (naked barley smut); of *Ustilago avenæ* (Plates I, IV, V), gives history, synonomy, injuries to host plant, different varieties attacked, amount of damage (in general over 8 per cent., at Manhattan, Kans., 10 per cent.), geographical distribution, botanic and microscopic characters of the smut, germination of spores in water, germination of spores in nutrient solutions, infection of the host plant (historical), methods of treatment (mechanical, chemical, and physical, with description of Jensen's hot-water method and report of successful experiment with same): notes a new form of oat smut (*Ustilago avenæ* var. *levis*, Kell. and Swingle.) Of *Ustilago tritici*, (Pers.) Jensen (Plates II and VI), history, synonomy, injuries to host plant, geographical distribution, characters of the smut, germination of spores in water, germination of spores in nutrient solutions, prevention. Of *Ustilago hordei*, (Pers.) Kell. and Swing. (Plates II and VII), gives history, synonomy, nature of injuries to host plant, geographical distribution, characters of the smut, germination in water, germination in nutrient solution, manner of infection of host plant, methods of prevention. Of *Ustilago nuda*, (Jensen) Kell. and Swing., gives history, synonomy, injuries to host plant, geographical distribution, botanical and microscopic characters of the smut, germination of spores in water, germination of spores in nutrient solution, manner of entering the host plant, methods of prevention. Natural enemies of the smut (Plate IX), *Fusarium ustilaginis*, Kell. and Swing. *Macrosporium utile*, Kell. and Swing., *Bacterium* (?) sp. Smut-eating beetles, *Phalacrus politus* or *penicillatus* and *Brachytareus variegatus*, Say. Gives note also on stinking smut of wheat (Plate III), caused by *Tilletia fœtens*, (B. and C.) Trel. and *Tilletia tritici*, (Bjerk.) Wint.

157. ———. **Preliminary experiments with fungicides for stinking smut of wheat.** Bull. No. 12, August, 1890. Kansas State Agr. Exp. Sta., Manhattan, Kans., pp. 27–51 with Plate I. Give as introduction, amount of damage, cause of disease, growth of characters of parasite, germination of spores, comparison of loose and stinking smut, mode of infection. Report on use of 51 different treatments for disease, deciding Jensen hot-water method most successful (see p. 117 this number of the JOURNAL.)

158. LONG, E. A. **Plum-leaf blight or shot-hole fungus.** Pop. Gardening, Buffalo, N. Y., Vol. V, No. 12, p. 249, 1890. Notes *Septoria cerasina*, Pk. (with sketch). Recommends burning dead leaves, and spraying early in season with Bordeaux mixture.

159. MCMILLAN, CONWAY. **Note on a new species of Actinoceps, B. and Br.** American Naturalist, August, 1890. Vol. XXIV, No. 284, p. 777–779. Describes as new *Actinoceps Besseyi*, McM. found on putrid orange skin among bacteria, thinking difference in size of stipe and head sufficient to separate it from *Actinoceps Thwaitesii*, B. &. Br.

160. MEEHAN, THOMAS. **Fairy rings.** Cult. and Country Gentleman, Albany, N. Y., January 16, 1890, Vol. LV, No. 1929, p. 48. Gives history and description, referring cause to species of *Agaricini*, varying with different cases. Divides rings into two classes: one with dead grass in center, other with ring only.

161. PAMMELL, L. H. **Treatment of fungous diseases.** Orange Judd Farmer, Chicago, Ill., November 1, 1890, Vol. VIII, No. 18, p. 277, ½ column. Notices shortly history of growth of this line of mycology.

162. ———. **Pear-leaf blight.** Orange Judd Farmer, Chicago, Ill., October 25, 1890, p. 261, Vol. VIII, No. 17. Gives extended notice of work of U. S. Dept. of Agr. against *Entomosporium maculatum*, Lév. in season 1889–1890 (see No. 11).

163. ———. **Pear or fire blight.** Orange Judd Farmer, Chicago, Ill. Vol. VIII, No. 13, September 27, 1890, p. 197. Gives short history with observations and recommendations of treatment.

164. ——— **Strawberry-leaf blight.** Orange Judd Farmer, Chicago, Ill., August 23, 1890, Vol. VIII, No. 8, p. 115 (with figures). Gives popular exposition of disease caused by *Sphærella fragariæ* Sacc., methods which have been used and recommended in its treatment.

165. ——— **Strawberry-leaf blight.** Iowa State Register, Des Moines, Oct. 17, 1890, p. 7. Gives popular description with recommendations for treatment, viz, garden hygiene and fungicides, making reference to work of U. S. Dept. of Agr.

166. PANTON, J. HOYES. **Black-knot on plums.** Bull. LII., January 16, 1890. Guelph, Ontario. Describes the fungus popularly. Recommends destruction of diseased parts and removal of wild choke-cherry trees adjacent to orchards.

167. PECK, CHARLES H. **A. Plants added to the herbarium. C. Plants not before reported. D. Remarks and observations. E. New York species of Armillaria. F. Communication by P. H. Dudley in reference to decay of railroad ties.** Ann. Rep. State Botanist of New York, from 43 Rep. of N. Y. State Museum of Nat. History, Albany, N. Y., March 21, 1890; pp. 1–54, with 4 plates. Gives the usual list of additions to the herbarium, with notes on destructiveness of *Monilia fructigena, Glœosporium ribis, G. lagenarium, G. Lindemuthianum, Rhopalomyces cucurbitarum, Pernospora viticola, Phytophthora infestans* (with trials of Bordeaux and methods of deep planting to prevent the disease). Notes disease of oats in St. Lawrence County, thought to be due to *Fusicladium destruens*, n. s. and describes forty-two new species of fungi with numerous valuable notes upon old and new species, adding a short monograph of the eight known New York species of *Armillaria*. Appends interesting letter from P. H. Dudley upon fungi attacking railroad ties and other timbers. The species described as new are as follows: *Tricholoma grave* (with figs.), *Clitocybe multiceps, Coprinus brassicæ* (with figs.), *Cortinarius* (*Phlegmacium*) *glutinosus, C.* (*Inoloma*) *annulatus* (with figs.), *C.* (*Dermocybe*) *luteus, C.* (*Telamonia*) *paludosus, Lactarius subinsulsus, L. mutabilis* (with figs.), *Russula brevipes* (with figs.), *Marasmius albiceps* (with figs.), *Poria aurea, Irpex rimosus, Corticium mutatum, C. subaurantiacum, C. basale, Peniophora unicolor, Clavaria similis, Comatricha longa* (with figs.), *C. subcæspitosa* (with figs.), *Phyllosticta bicolor* on *Rubus odoratus, P. prini* on *Ilex verticillata, P. silenes* on *S. antirrhina, Phoma allantella* on *Quercus rubra, Plasmopara viburni* on *Viburnum dentatum, Sporotrichum cinereum, Coniosporium polytrichi, Stachybotrys elongata* (with figs.), *Dematium parasiticum, Fusicladium destruens* (with figs.) on *Avena sativa, Macrosporium polytrichi, Tubercularia carpogena, Fusarium sclerodermatis, Glœosporium leptospermum*, UNDERWOODIA gen. nov., *U. columnaris* (with figs.), *Helotium mycetophilum, Hæmatomyces faginea* (with figs.), *Eutypella longirostris* (with figs.), *Lepiota farinosa, Pholiota æruginosa, Phellorina Californica.*

168. PORTER, MISS E. **Notes on spore discharge of ascomycetes.** Bull. Torrey Bot. Club., New York, September, 1890, Vol. XVII, No. 9, p. 238. Abstract of paper read August 26, 1890, before Botanical Club of A. A. A. S., Indianapolis, Ind. Gives observations of this process in *Pleospora.*

169. REX. GEORGE A. **A remarkable variation of Stemonitis Bauerlinii, Mass.** Proc. Nat. Sci. Ass'n, Staten Island, No. 11, August, 1890. Notes curious case of reversion of an extremely variant form to the original Stemonitis type. Records the variation as *S. Bauerlinii* var. *fenestrata*, Rex.

170. RUSSELL, H. L. **Penicillium and corrosive sublimate.** Bot. Gaz., August 25, 1890. Vol. XV, No. 8, p. 211. Notes Dr. Coulter's remark in March number of Gazette, giving plate-culture tests with percentage solutions of mercuric chloride. Finds the fungus no more able to stand presence of germicide than other species, when the latter is thoroughly mixed in the media.

171. Scribner, F. L. **Pear scab.** Orchard and Garden, Little Silver, N. J., August, 1890, Vol. XII, No. 8 (with figs.). Gives description of disease caused by *F. dendriticum*, (Wallr.) Fckl., considering the latter synonymous with *F. pyrinum*, (Lib.) Fckl. Shows necessity of early spraying. Recommends ammoniacal copper carbonate.

172. ——— **The powdery mildew of the rose.** Ibid, p. 144 (with figs.). Describes disease carefully, giving for remedies sulphur and potassium sulphide.

173. Southworth, Miss E. A. **A new hollyhock disease.** Bull Torr. Bot. Club, Vol. XVII. No. 9, September, 1890, p. 235, N. Y. Notice of paper read by B. T. Galloway before Botanical Club A. A. A. S., Indianapolis, Ind., August, 1890. Describes diseases as caused by *Colletotrichium althææ*, n. s.

174. Weed, C. M. **The potato blight.** Am. Agriculturist, New York. Vol. XLIX, No. 7, p. 360. Notes successful attempts to control ravages of *Phytophthora infestans* with the Bordeaux mixture. Gives formulæ and method of treatment.

175. ———. **An experiment in preventing the injuries of potato rot.** Sci. Am., April 5, 1890, Vol. LXII, No. 14, N. Y., p. 217.

176. Yeomans, W. H. **Bean rust and other fungous diseases.** Popular Gardening, Buffalo, N. Y., November, 1890, Vol. VI, No. 2, p. 27. Notes very destructive fungous diseases of bean leaves. Scientific name not given.